Nature Magazine

VOLUME 34 NUMBER 2

FEBRUARY 1941

35 CENTS

Pep Up Your Meetings

Motion pictures of Nature and the Outdoors will take you far and wide in the world of the wild.

Schools; Garden Clubs; Women's Clubs; Nature and Hiking Clubs; Boy and Girl Scout Troops; Church, Civic and Fraternal Organizations; Sportsman and Conservation Groups will be interested in these motion picture films. Thrilling, educational motion pictures help to boost attendance at meetings. They make meetings more interesting and help to promote some educational activities by increasing a knowledge of Nature and the outdoors; developing a consciousness of the need for practical conservation of our national resources and the protection of wildlife.

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For forty years William L. Finley has been shooting wildlife. But everything he has shot still lives for it was shot with a motion picture camera. More than two hundred thousand feet of film now carry the record of his camera hunting.

The American Nature Association commissioned Dr. Finley to edit eighteen 400-foot reels of 16 millimeter motion picture film, drawing upon the best of his material. Thus 200,000 feet of 35 millimeter film are condensed into the equivalent of 18,000 feet of the best shots of all.

These interesting, entertaining and educational films are grouped as follows:

GROUP I: Specially adapted for school use and for juvenile audiences.

11. *Babes in the Woods:* The life of Nature's young in the wild.
12. *Wild Animal Pets:* A naturalist's dog into whose life came many strange animals.
13. *Renting Houses for Songs:* An intimate study of bird life.

GROUP II: A spectacular series of Alaskan reels.

21. *Cruising North:* Murres, sea puffins, bear and other coastal wildlife.
22. *Off to Glacier Bay:* Spectacular pictures of the face of a glacier breaking off and plunging into the bay. Also wildlife scenes.
23. *Wild Animal Outposts:* Hardy Island deer, ptarmigan, bear cubs, blue fox, fur seals of the Pribilofs.
24. *Thar She Blows:* Whales at sea.
25. *Great Bear of Alaska:* Films of the great Kodiak bears of Admiralty Island.

GROUP III: Southwestern series.

31. *Wings to the South:* Bird life of the Texas Gulf coast and the southwest.
32. *Riding the Rimrock:* Searching the rough country of the southwest for its wildlife.
33. *Nature's Side Show:* The struggle for existence in the arid southwest.
34. *Queer Creatures of the Cactus Country:* A study in the adaptation of wildlife to a harsh land.
35. *Getting Personal with Mountain Lions.* A thrilling picture of a pack trip into lion country.

GROUP IV: Photographed along the Continental Divide.

41. *The Big Game Parade:* You meet Antelope, Mountain Sheep, Mule Deer, Elk, Bison, Moose, Brown Bears and Grizzlies.
42. *The Forests:* Forest Fires, Birds, Beaver—greatest conservationist of all—at work.
43. *When Mountains Call:* The life of the high places is thrilling to see. Water Ouzel, Ptarmigan, American Eagle, Big Horn Sheep, Wapiti—American cousin of the European Stag.
44. *Ramparts of the North:* Filming big game requires endurance. Glaciers, Hoary Marmot, Caribou, Moose, Black Bear.
45. *Getting Our Goat:* Mountain Goat on its native crags. Ground Squirrels, Cony, Grouse.

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About the Redwoods

A library of information is to be found in the four excellent pamphlets published by the Save-the-Redwoods League, the organization that, as its name implies, has led the movement for preservation of substantial areas of these great trees of the West Coast.

Trees, Shrubs and Flowers of the Redwood Region, by Dr. Willis L. Jepson, discusses the flora associated with the Redwoods and gives many photographs and drawings of them. A valuable feature is a page illustrating and describing the various ferns found in the Redwood belt.

A Living Link in History is a statement by the President of the League, Dr. John C. Merriam, of the spiritual and esthetic significance of the Redwoods.

Dr. Ralph W. Chaney of the University of California wrote the pamphlet entitled *Redwoods of the Past,* which describes the long descent of the trees themselves, telling of their migrations in ages past.

In *The Story Told by a Fallen Redwood,* Professor Emanuel Fritz of the University of California shows, through charts, how the happenings in the life of a "down tree" can be told by studying its cross sections.

The mail address of the Save-the-Redwoods League is 219 California Hall, University of California, Berkeley. Each pamphlet in the series is 10 cents a copy.

Hiking in the Wilderness

Last year we called to the attention of our readers the inauguration of a group of hiking trips into a western wilderness under the leadership of H. Frank Evans. The first year proved highly successful and among the thirty-seven hikers who joined one or another of the six trips conducted, four were members of the American Nature Association. Mr. Evans writes us that the guests and staff covered an aggregate of 5500 miles without a single mishap and with many unscheduled thrills. A series of trips is now planned for 1941, and the route will be into the newly-created Robert Marshall Wilderness Area that straddles the Swan and Flathead ranges on the rugged northern Rockies. The trips will take ten days, so that two-week vacationers from the East can take advantage of them. Full details as to the cost and program of the trips may be obtained by writing to H. Frank Evans, 301 W. Cherry Street, Carbondale, Illinois.

Two Events

The American Institute Science and Engineering Clubs, in cooperation with the American Museum of Natural History, announce two outstanding events for this spring. The first is the Fourth Scholastic Salon of Photography to be held February 15 to 23 and open to amateur student photographers between the ages of eleven and eighteen. The second is the Thirteenth Annual Science and Engineering Fair from April 27 to May 4. For the latter entries are invited from junior and senior high school students who wish to show tangible evidence of constructive progress in club and classroom work in science. Three thousand dollars in prize awards will be distributed. Full details about both events may be obtained by writing to The American Institute Science and Engineering Clubs, 60 East 42nd Street, New York City.

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Camera Trails

BY NORRIS W. HARKNESS

Developing a Negative

So many letters have asked for the outline of a development procedure that I am going to answer them en masse. Let us begin with a sketch of what happens in the developing process.

The film has been exposed, which means that the various areas of the emulsion have been affected by light in proportion to the brightness of the objects in the picture before the camera. The chemicals in the emulsion have the faculty of turning black in proportion to the strength of the light that hit those areas, so when the negative is developed the parts that correspond to the brightest areas in the picture are dark and those that represent the darker places and the shadows are lighter. If the negative has been properly exposed, no area is without some slight tone, and none is opaque. Thus, in the printing, light can penetrate the whole negative to be recorded on the paper just as it should to give a perfect picture.

However, it stands to reason that changing the amount of the development will alter the amount of the deposit on the film, and it works out that greater development has a tendency to affect the darker areas of the negative more than it does the lightest places, with the result that the contrast of the final negative is increased. This is just a shorter way of saying that the difference between the lightest and darkest spots in the negative is greater so that the whites in the print will be whiter and the blacks will be blacker than they would be with less development.

I say "greater" and "less" development rather than longer or shorter because the degree of the development depends on other factors than the time the film is in the solution. Chemical reactions are faster at higher temperatures, so naturally the negative develops more in the same length of time when the thermometer is higher. Furthermore, if the solution is agitated throughout the development period each tiny droplet of chemical is continually being replaced with a new one, while if there is little or no agitation, the same drop continues to work on its spot on the emulsion until it is exhausted. So more agitation, like higher temperature or longer time, results in greater contrast in the negative when it is ready to print.

When we realize the tremendous variations in the light and the brightness range of the pictures we make, and the fact that each one requires thoughtful changes in the exposure if we are to get the best pictures, we see that no real standardization is possible —except in our thinking—in the camera part of picture making. But we can eliminate one main cause of failure by adopting one changeless method of developing; a method that uses the same developer all the time in accordance with the directions of the maker of our film. With a standardized method we will avoid having any more under- or over-developed negatives and our batting average will improve sharply. Of course, with the innumerable variables in photographic processing we will always have an occasional failure and many of our pictures will not be perfect, but if the errors in development are eliminated a far larger proportion of our negatives will be capable of producing good prints.

By standardized development we mean just this. We use the one developer suggested by the film maker in strict accordance with his directions; we measure the temperature with a thermometer and not with a finger stuck in the solution; we time the development period accurately for the temperature; we agitate the tank or tray according to a definite standard so that every film is subjected to exactly the same treatment the others receive; and we keep the developer, the stop-bath if we use one, the hypo fixing bath, and the wash water at as close to the same temperature as we can manage. It may be that we will find that the manufacturer suggests ten minutes for the film we are using, but that we find we have to use a rather hard grade of paper for most of our prints—an indication that our negatives lack contrast. In such an event we will increase the developing time to perhaps twelve minutes for that temperature and add a corresponding amount to the suggested time for other temperatures. It becomes merely a standard procedure based on the maker's directions and altered slightly by our experience to suit our own conditions.

The actual developing of a film will begin with loading it into the tank or laying out the trays in an absolutely dark room. Modern fast emulsions cannot safely be developed in trays if there is the slightest amount of white light present. If we use

"CLOSED FOR THE WINTER"—ONE OF THE OUTSTANDING HONORABLE MENTION PHOTOGRAPHS SUBMITTED IN NATURE MAGAZINE'S 1940 PHOTOGRAPHIC CONTEST. THE PHOTOGRAPHER—H. W. GILBERT, DULUTH, MINNESOTA.

orthochromatic film, we can have a very dim red safelight, but Verichrome and Plenachrome are so sensitive to all but the absolute spectral red that enough of even the red safelight to let us see much will run the risk of fogging the film, so it is better to do all developing in absolute darkness. The same applies to panchromatic films that are supposedly comparatively insensitive to faint green light. The only safelight regularly used in my own darkroom is the one I use for paper, and all my development is done in the dark.

But space is running out. Next month we will take up tray and tank development with various films.

Nests

Now, with the trees bare and the visibility at its highest for the year, is the best possible time for the careful study of birds' nests. To be sure, the elements have done some damage to the more delicate parts since their owners departed, but the method of attachment and the architectural details may be seen more clearly now, and there is the added advantage of not needing to disturb or frighten the birds to make the pictures.

Such a study has several uses in addition to the accumulation of better knowledge of the birds in your neighborhood. There is the possibility of using the shots as part of a series to show the life history of some one species by shooting the making of the nest in the spring, the eggs in it a bit later, the youngsters at feeding time, the first flying lessons, and the other pictures that will make the story more nearly complete. You will show them in chronological order, of course, but that does not mean that you will or can shoot them in that order. If you have ever tried a Nature series, you know that they often begin with one exceptionally good shot that leads to another and another until the series is finished. Then, as the years pass, you make others that are better than the first and replace them gradually with better and better pictures. So it does not matter where you start the group, and since this is the season for the bare nests, you might as well begin there.

As is so often the case in Nature pictures, a long-focus lens is a great help because it gives you a bigger image on the film at greater distances from your subject, and hence allows you to work from more comfortably and more easily attained viewpoints. Yet, with a little care in placing the camera, the necessary shots may be made with your regular lens without too much difficulty. Probably you will want several angles, including one shot from above and as close to the nest as you can focus to show the materials clearly and the method of lining the harder outside framework. Another should show the shape plainly outlined against the sky, and others ought to include the position on the branch and the way it is held in place, and the most usual location in the tree.

This first group of the series, then, will show where the nest is likely to be found in the tree; the kind of tree most used by this bird; the attachment of the nest to the branch; the materials used in its making, and the shape and actual construction of the nest itself.

But now for the how to do it. There are so few leaves that the light will be better and the exposures may be fairly short, but there is the ever-present need for a steady camera if your negatives are to be sharp. If the exposure is longer than 1/25th second, do not try to hold the camera in your hand, and even at that speed do not do it if your position is cramped or uncomfortable. The light and the stop you need for sufficient depth of field will determine the shutter speed, but try to keep it as high as possible. Use a tripod, or fasten the camera in place with an Eastman Optipod, or by tying it carefully to another branch, unless you are certain of steadiness.

The color of the nest can bring up another question. Usually both the nest and the surrounding branches are about the same shade of gray or brown, so a filter will not be much help in separating them, but try a medium yellow filter if much sky is included in the picture area to give it a tone that will print more like sky, even though it will not help to make the nest stand out. Since, then, you can not do much to distinguish the nest by its color, the alternative is to use the direction of the light to separate it from its background and to make it occupy so much of the film area that there can be no mistaking the subject matter.

With small nests on the ground, or in other locations that permit close work, a supplementary close-up lens may be used to get a larger image. These lenses, sometimes miscalled "portrait lenses", slip on the lens mount and enable you to focus down to short distances with the ordinary folding camera. They require careful measuring of the distance from the lens to the nest and the use of rather small stops to get enough depth of field, but if they are used correctly, they will give excellent results.

Remember, too, the advantages of a white reflector on the dark side of the nest. A large sheet of cloth or paper will reflect light into the shadows and give you detail everywhere without losing the three-dimensional effect that comes from having the light from one side.

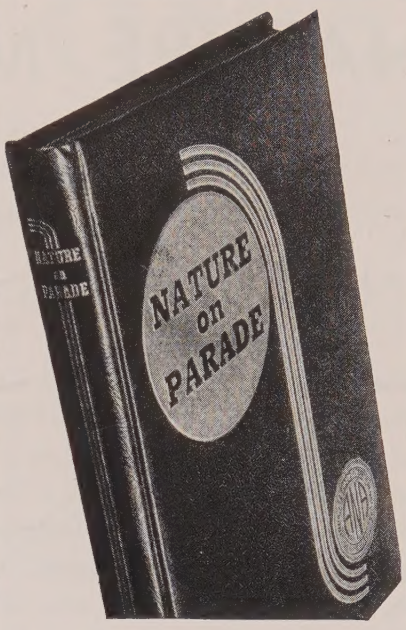
So, except for those cases where the nest's location demands special gymnastics, photographing birds' nests becomes quite like the picturing of any other small objects whose details and texture are important, and you have only to consider each detail of the task and settle its handling to make good pictures that will be not only good records for your series, but also in many cases have real pictorial merit.

This and That

Willoughby's, Inc., 110 West 33rd Street, New York, has announced the Hugo Meyer f/4.5 enlarging lens with a 3½-inch focal length at a low price. Called the Metar, the new lens is fully color-corrected, has a flat field, and gives excellent definition. Willoughby's has also announced the Gem enlarging easel for paper up to 8" x 10". The Gem has adjustable masking strips that will accommodate paper of any size up to the maximum. Write to the above address for their bargain catalog.

The Federal 121, 219, or 222 enlargers for negatives up to 2¼" x 3¼" are well constructed and inexpensive. They have a

(Continued on page 116)



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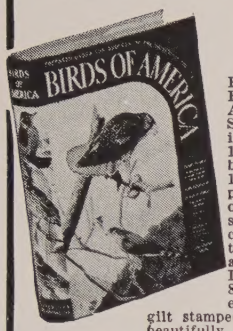

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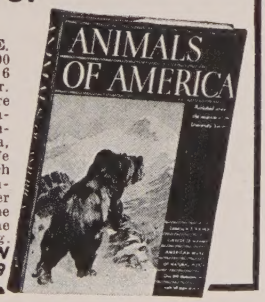

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THE SINGING HUMMINGBIRD

By FRANCES H. STACKHOUSE

I am told that hummingbirds do not sing, though we often hear them make a quaint little note while gathering food from flowers. On September 7, 1940, at seven A. M., a hummingbird perched on the leafless twig of a yellow-flowering tree at the end of the sleeping-porch at the home of Mrs. D. L. Montonna near Orange, California. The hummingbird was singing a lovely song—with its throat fluffed out full like a canary's—joyous and bubbling. It flew away for a moment, came back to the same twig, facing the pepper tree, and sang again its joyous sweet song, flew away a second time and returned to the same twig and sang the third time very sweetly. Then it flew away.

Today, October 25, we have been having our first fall rain, gentle and steady. Just as I finished copying this paragraph I went into a concrete shed and there was a hummingbird trying to get out at the window. When I tried to slide the window sash to one side to free it, it went to another, and I tried to guide it to a hole in a pane that it might escape. I covered it with my hand, and to my amazement it did not try to escape, but lay in my hand as if to rest. And as it lay I raised it to the hole in the window-pane, and it gladly flew through into the rain and out of sight. It was very tiny and light in weight and had bright green plumage.

EDITOR'S NOTE: Ornithologists tell us that Anna's hummingbird, *Calypte anna,* is the only one inhabiting California that can be credited with a real song. This species is also notable for its habit of remaining well into the fall, and still indulging in song. Undoubtedly this is the species observed by Mrs. Stackhouse.

Biology Teaching

The Teaching Biologist is the interesting and well-edited magazine of the New York Association of Biology Teachers, and during the last year or so has produced some outstanding issues that contain courses of study, teaching techniques, testing devices, bibliographies and other practical materials. The editors call to our attention—suggesting that we pass it along—a special offer of five outstanding issues dealing with anthropology, consumer education, genetics and Nature (two issues)—all available for one dollar. Orders should be sent to Philip Goldstein, Walton High School, Reservoir and Jerome Avenues, The Bronx, New York.

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More than 1700 species and varieties of plants indigenous to the vicinity of Watchung, New Jersey, which includes the western end of Union County, are listed in a mimeographed booklet now available to Nature students from the Union County Park Commission, Warinanco Park, Elizabeth, New Jersey. Copies are mailed for fifteen cents, or may be had free if one is close enough to appear in person to request one. The list is the result of a botanical survey by Dr. Harold N. Moldenke, who reports that the list of flowering plants is quite complete, but that much work yet remains to be done with the lower forms.

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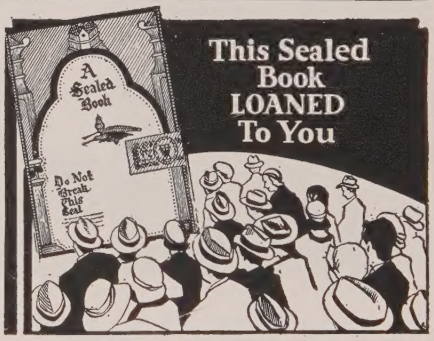

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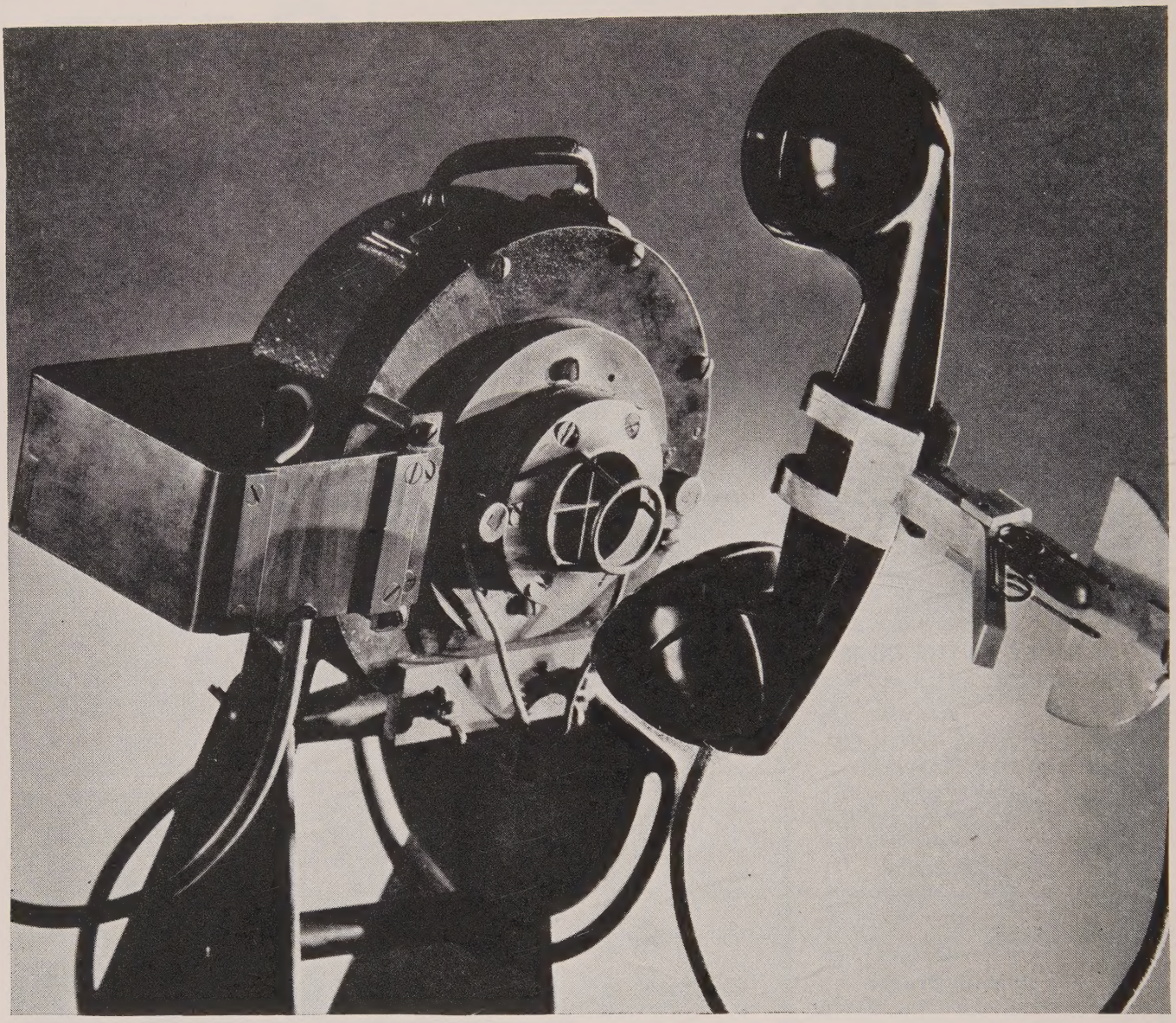

SAID THE ELECTRICAL MOUTH TO THE ELECTRICAL EAR . . .

"*Joe took father's shoe bench out.*
She was waiting at my lawn."

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Nature in Print

By HOWARD ZAHNISER

THE "life histories" of great naturalists are not only commentaries on their own contributions to knowledge but also, combining significance and interest in the manner peculiar to Biography, they share the value placed on all documents of human life.* This seems especially true of the naturalists who founded and advanced this science in America. Donald Culross Peattie felt that his annotated collection of writings by John James Audubon, recently published by Houghton Mifflin, was a rousing chronicle of Audubon's times. He called his book *Audubon's America,* and its many readers have agreed with him. The same feeling results from the reading of biographies of such varied naturalists as the Bartrams, Louis Agassiz and William S. Sullivant, works that by the coincidents of reviewing have come to attention at the same time. The significance of natural history has been emphasized in many ways in America, by conservationists, sociologists, economists, literary and art critics, philosophers, historians, and writers. Its depth has been apprehended, but perhaps the variety of its implications is much greater than has yet been imagined. Possibly it is not going too far to say that the entire important history of America could be told in a comprehensive treatment of the continent's natural history and the naturalists who have written it. The possibility depends not only on the basic importance of natural resources and natural influences, but also on the varied interests and character of the Americans who have been naturalists.

John Bartram was born in 1699. His son William died in 1823. Agassiz and Sullivant, students at the time of Bartram's death, both died in 1873. No one, I believe, could study their biographies without feeling that they had come across valuable collateral reading for the history of America from early in the eighteenth century to the birth time of the venerable citizens of our own day.

John Bartram, in the eighteenth-century world which, as Professor Earnest remarks, "seems strangely small," was a Quaker farmer on the outskirts of Philadelphia. According to the traditional account based on Crevecoeur's writings, Bartram picked a daisy one day and, on appreciating its structure, said to himself: "What a shame . . . that thee shouldst have employed so many years in tilling the earth and destroying so many flowers and plants, without being acquainted with their structure and uses!" Bartram continued to cultivate the farm, which is now a botanical garden surrounded by Philadelphia, but he became also an outstanding botanist, and a friend of Benjamin Franklin and many other important men on both sides of the Atlantic. He made expeditions into the frontiers of his world. His son continued his botany and travels, with an added poetic interest, and in his later years quietly cultivated the garden and his own mind. From the Bartrams came not only botanical, geographical, and ethnological knowledge but also a philosophy of Nature that touched the heart through the writings of the romantic poets.

"Compared with the solemn, standardized writing of much of the science and scholarship of today," says Professor Earnest, "the gusto and humanity of Bartram's *Travels* is like a spring wind after a long winter. . . . The Bartrams could study the structure of a plant and still see its beauty and classify a bird while listening to its 'seraphic music.' They knew that beyond all their knowledge there was a mystery of the universe, and that men would listen eagerly to him who could tell of adventures and discoveries in the unknown."

How eagerly they will listen was never demonstrated more effectively than by the crowds that rushed to the lectures by Louis Agassiz, the systematic naturalist, classifier of fossil fishes, student of geology and glaciers, who emigrated to America at the height of his powers in 1846 to find a nation convinced "that if you understood Nature, you were in a fair way to understand life," and convinced too that "Louis Agassiz was best fitted to tell them about nature." The "back-to-Nature tendencies" which had been stirring when Agassiz was a young man were "at their height," says Miss Robinson, when he arrived in America. Their effect has never disappeared, she says, and now we take it for granted that a child will learn "in school anything that he should know about the flora and fauna of the world." The ease with which students can now learn about natural history in school is due not only to the influences of these continuing "tendencies" but also, in part, to the methods developed by Agassiz—a genius not only in obtaining and classifying knowledge, but also in sharing it with others on the lecture platform or in the classroom.

A different sort of scientist was William S. Sullivant, and yet his contribution to our present knowledge and ease of learning is also great and invaluable. The story of his life that Mr. Rodgers has written is an account of the settlement of Kentucky and Ohio by Virginians, of the rise of Columbus, Ohio, and of the financial success that came to the Sullivants from real estate and other enterprises. But it is also the story of the "father of American bryology," the story of a well-to-do American business man and at the same time a (Continued on page 111)

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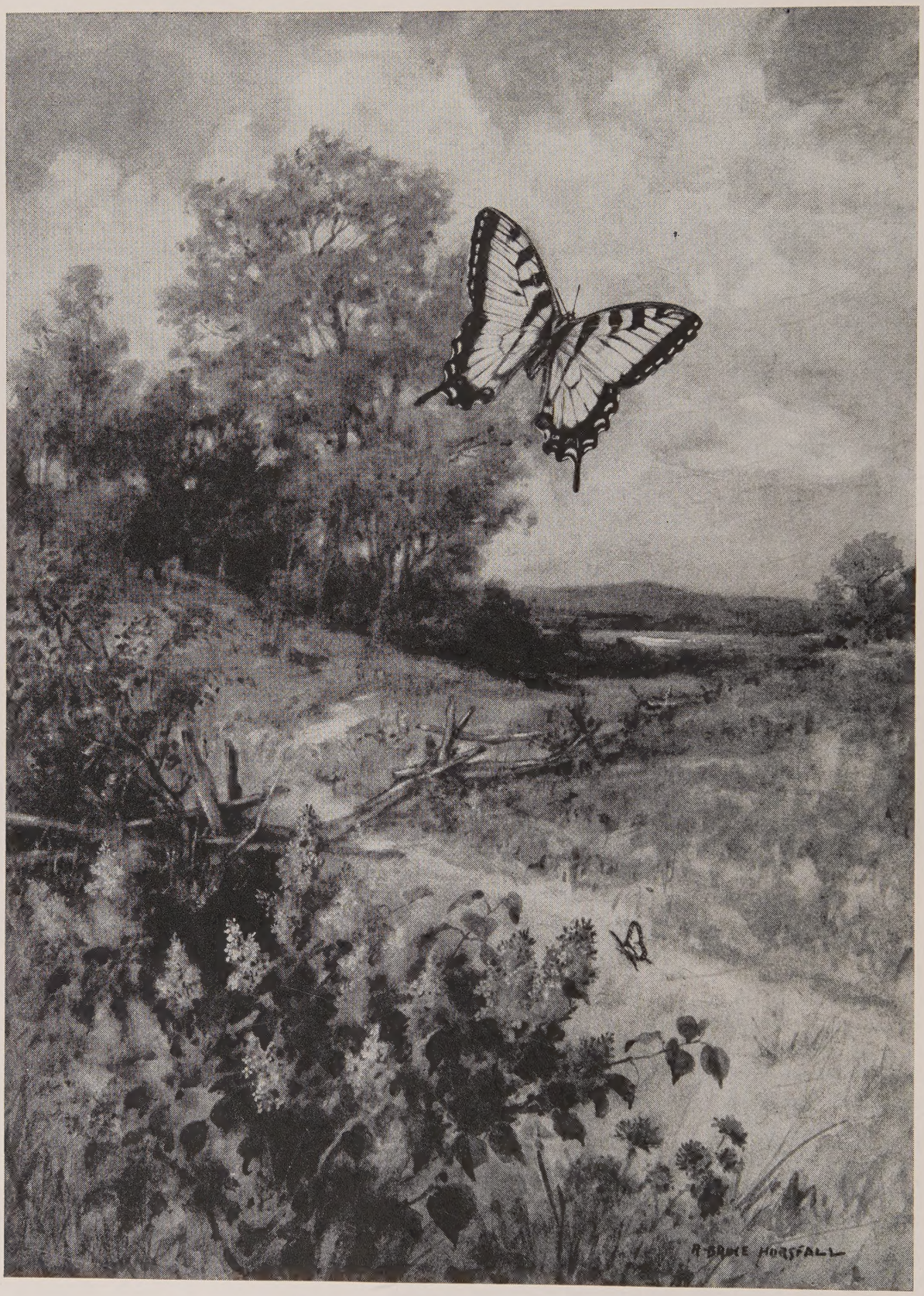
*Books discussed in this article are as follows:

John and William Bartram: Botanists and Explorers: 1699-1777, 1739-1823. By Ernest Earnest. Philadelphia: University of Pennsylvania Press. 1940. 187 pp., with portraits, foreword by Conway Zirkle, bibliographical note, and index. $2.

Runner of the Mountain Tops: The Life of Louis Agassiz. By Mabel L. Robinson. New York: Random House. 1939. 290 pp., with decorations by Lynd Ward, 8 color plates of fishes, an alligator, and turtles, bibliography, and chronology of the life of Agassiz. $3.

"Noble Fellow:" William Starling Sullivant. By Andrew Denny Rodgers III. New York: G. P. Putnam's Sons. 1940. 361 pp., with 25 illus., foreword by Dr. Adolph E. Waller, a compilation by Richard T. Wareham of the new species of mosses and liverworts described by Sullivant and those described by Sullivant and Leo Lesquereux, bibliographies, and index. $3.50.



"TIGERS ARE NOT BUTTERFLIES, THEY ARE SYMBOLS—SYMBOLS OF ULTIMATE SURVIVAL AND OF VICTORY—SYMBOLS OF AN OVER-LAW AT WORK TODAY AS IT WAS IN THE COUNTLESS YESTERDAYS."

NATURE MAGAZINE
VOL. 34 · FEBRUARY · 1941 · NO. 2

Boarding Tigers

By EDNA PECK ATWOOD

Illustrated by R. Bruce Horsfall

At a time when much of the country is under the sway of snow or winter's cold, we are indulging an editorial whim and presenting northern readers with a breath of summer. It is, however, not too inappropriate to a winter issue to tell about a butterfly because its life cycle extends around the calendar. We feel, moreover, that such a beautiful piece of writing and such a sentient recording of observation as Edna Peck Atwood gives us here knows no seasonal limitations.

JUNE 22. Nature's substitutions are unpredictable. Hunting among lilacs for Promethea caterpillars, I find an unimpressive, quarter-inch tiger swallow-tail. Although so small this Tiger is already a weaver—solitary, sufficient to himself, taking his ease aloof on the gossamer he has made without instruction, yet exactly following the mysteriously transmitted pattern of his kind. Self-absorbed, perhaps in inherited volant dreams, he clings to his carpet with pro- and prop-legs only. His enlarged thorax is elevated and his six, hook-tipped, true-legs hang inert under his chin. It is the enlarged forebody and the web that indentify him as a swallow-tail; color does not. Some day he will have a smooth green skin with eye-spots on his third segment, but in this early babyhood he is brown with an angular cream-colored band on mid-back. A magnifying glass discloses a lacy skin design and minute tubercles in pairs. The largest pair has wee hairs—setae. A profile view shows his head and his sixteen legs, ever so tiny but competent.

Close by is the jagged opal rim of the egg that lately compassed him, and a daintily incised margin proves that Tiger is living both on and off his leaf. Deciding to pry deeply into his affairs and mindful of the gamut of risks the open holds, I corral him in a deep kitchen pan. His twig is erect in a tumbler of wet sand. A pasteboard tumbler-cover intervenes between him and a puddle-tragedy. Former studies make his behavior dependable; he will not wander from this caterpillar sanctuary until maturity *if* I set a savory table.

During scrutiny Tiger's twig is tilted freely but to him, I am a breeze; to me, he is a landlubber with sea legs. He stirs the fancy that a rocked baby should be a good voyager. As all my Tigers have done, he fasts for hours after housing, as if disturbed by change. This fellow, eventually to be known as Tiger I, at last goes to pasture, nibbles, and returns to bed, undallying, by the same route. Amazing baby!

JUNE 29. Tiger forages afield to-day. He crosses to the opposite leaf and dines from its fresh edge, homing again at once. He has grown to five-sixteenths of an inch.

JULY 1. On a maiden trip to the next lower tier of leaves he spreads a web frame. (Later he adds to this a little at a time until it is substantial.) Having staked a claim, Tiger rests long without eating. Set in the sunshine of a screened doorway, he promptly becomes sleepy and, dozing, leans far back, clinging to his web with only four legs. Time and again a fall seems imminent but he jerks back to balance, like a drowsy person nodding in a chair.

Bright sunlight favors study. Above his brown face, between those foremost tubercles, is a ridge that I soon learn is the mouth of his scent pouch. He has regularly-spaced brown warts and milk-white dots. The tubercles near his tail are joined by a line of pale cream. His underparts and his sash are turning greenish. (While raising Tigers I learn that color can change gradually, and that warts and tubercles can shrink without a change of skin.)

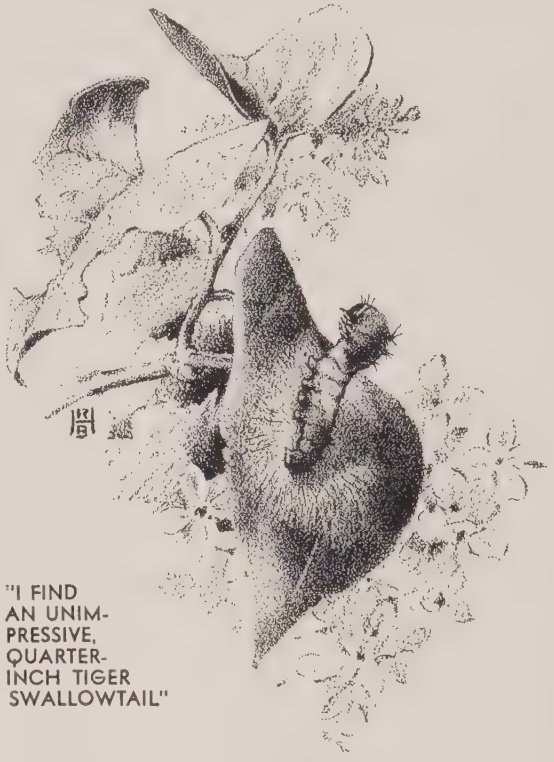
Curiously enough, about my mealtime, Tiger remembers his. He starts down grade to the leaf edge, spinning, as he goes, a single thread so fine that seeing him spin and fix it to the leaf is the only proof it is there. Having eaten, he returns but does not spin nor deviate from the outbound path. It dawns on me that he has been using

a guide line all along, although it had not before been noted.

JULY 4. Food low and stale. I attempt a peaceful transfer to a fresh twig but Tiger clings stubbornly to his carpet. He runs out his scent organs in protest. When I finally succeed, he is entirely helpless, rolling around on the leaf. Part of the time he is on his back. I barely save him from a bad fall. He turns and twists and feels for a tailhold that doesn't exist. So is the discovery made that he is helpless without his web. It is a necessary footing. I roll him back upon his webby home leaf and he rights himself at once. He shall move when he pleases. I have tired him out.

JULY 6. Tiger elects to move. I find a doffed mask. The inconsiderate fellow has changed his skin and eaten it when I wasn't looking. He is seven-sixteenths of an inch long.

JULY 10. Tiger sheds his skin again to-day. I find him eating it. He is more than a half-inch long. His cream sash is relatively smaller. Rudimentary eye-spots on his third segment now look like eyes. A narrow cream-colored collar line along the back of his fourth segment makes his forebody resemble a head. His larger web now bridges the home leaf. He begins to dine out regularly—a gay blade.



"I FIND AN UNIMPRESSIVE, QUARTER-INCH TIGER SWALLOWTAIL"

JULY 14. I tie Tiger's old twig to a fresh one, snipping off all old leaves but the webbed one.

JULY 15. Tiger has not moved and I urge him. He violently throws out his orange-colored scent organs, osmeteria, which consist of two pouches having one neck in common—the whole now wrong-side-out. A wet filament, or flagellum, curls from each. Accidentally they touch a leaf and a copious trail of moisture spreads. So does an unattractive odor. Tiger? No. Skunk!

But the magnifying glasses give a clue to Tiger's obstinacy. Silk threads seem to bind his rear segments. I dispose myself to watch. Nothing shall cheat me! Ah! What resembles thread is thin old skin telescoping. Tiger's forebody rears. He writhes and twists in continuous convulsions. Presently his mask pops off. A few minutes and his true-legs are free. The old, transparent skin slips backward off his eye-spots and he begins to crawl slowly forward. I gape at his pliant pro-legs moving up and down in loosened gauze casings. Shade of Houdini! He's pulling out of ghost-boots two at a time! A few sidewise twists and his back tubercles are free. The cast skin collapses. Tiger is a nice bright fellow with a plum-colored face. But he is worn out with hard labor and fasting. He rests long before eating his shriveled old clothes and a portion of greens, thus maintaining a properly-balanced caterpillar diet.

JULY 20. Tiger grows greener. Yesterday his sash had faded to mere dots and to-day it is gone completely. He is one and three-eighths inches long. His cream collar has turned yellow, and a black piping along the front of his fifth segment trims it smartly. Four violet dots form a row in front of his collar. His eye-spots deceive all but the initiated. Black-rimmed violet irises, yellow and black rings, a straight black line and a violet dot apiece combine in a malevolent and startling expression. No, it wasn't man that invented the false face!

JULY 22. I have boarded Tiger one month. I get him fresh lilac leaves but he mopes.

JULY 23. Still the quiescence and the fasting. That silk-wrapped look again! The fourth molt is on! Oh—oh! His mask is half on; half off. Stuck! Eyes and mouth encased. Let's try a toothpick! I hold one gently at center crown. Tiger tosses his head impatiently and off flies the mask. We are both relieved. A deep constriction line furrows Tiger's face. Purple above, pale and pinched below; it takes half an hour for that funny-face to fill out and purple evenly. Meanwhile I salvage the mask and Tiger finishes ecdysis, which is what scientists call this process.

Um! What a blow to stylists and beauticians if folks grew clothes and fresh faces weekly as Tiger does! None could escape labor or fasting—although some would eschew baths and soap. And fancy the hopeless confusion of natural science if changes followed chance instead of fixed law!

JULY 24. Tiger ate one-third of a large leaf yesterday and finishes it to-day. He backs down the petiole and gnaws with vigor and determination until it falls. Then he cleans up the stump. It is as much to him as felling a sapling is to a beaver. He goes to bed with a proud air of accomplishment.

JULY 25. Tiger develops a family mannerism. Sister aptly dubs it "hiccoughs", for he jerks spasmodically.

JULY 29. Much current dinner leaf vanished in the night. Tiger eats by night as well as by day. Why not? The guide-and-grip line abets it. Tiger's impulse to gnaw off petioles is fixed. Would he discard false trails? Again, a useless petiole loosens in a few days; would he obviate a fall with one? Or would he keep ragged feeding grounds from betraying his presence? Who can answer?

JULY 30. Tiger is one and three-fourths inches long. Such an appetite!

AUG. 1. He breaks rules. He eats nest leaf—not done for three weeks. But who am I to say it is a rule?

"TIGER YIELDS TO WANDERLUST . . ."

AUG. 3. Five A.M. finds Tiger a deep, dull, poisonous green on forward and caudal segments. Those between are mottled green. Retrograding internal spasms follow one another. His yellow collar line becomes tan, then orange-tan, then henna. His head turns brown and his body grows continually browner until he is two-toned chocolate. Brown in babyhood, brown at maturity; this must be second childhood. Time makes it clear that the peristaltic convulsions empty the digestive tract. This is concluded, before he journeys, by the single flow of liquid of a Tiger's life. His traveling garb is now ready after five hours. He stretches contentedly, like a dog, and soon yields to wanderlust. Gone is his stay-at-home instinct and gone is his freedom, for I net him in a ready cage, a shoebox laid on its side, to give a cardboard ceiling and to prevent a hanging on the obscuring net. The box holds a leafless twig fastened on the oblique. Tiger may choose the plane of his gallows.

Around and around, up, down, often tumbling from the steeps that once would have lent him no footing at all, mills Tiger. Sometimes he erects himself and sways cobra fashion. At four forty-five P.M. he stops to hang himself—on the ceiling.

He first spins a flimsy foothold, then a mat with a central snag, or knot, for a tailhold. Pro-legs and prop-leg gripping these, he begins the noose. Twisting until spinnerets make contact beside right forward pro-leg, he fastens silk. Slowly he turns, spinning a loop, on, on to the left until he can fasten the thread beside his left forward pro-leg. The loop is about an inch long, the ends one-fourth inch apart. It is held taut by Tiger's doubled body as he turns. His true-legs are unused in sling making. He adds countless strands until it is easily visible. The sling ends have additional reinforcement. Thoroughness is his only life insurance. At last the loop satisfies Tiger. He wriggles through it, adjusting it after minor difficulties, between his fifth and sixth segments, where all Tigers do. His project is complete at five-fifty P.M. He is shrunken to one and one-quarter inches.

This Tiger hung quietly for twenty-two hours, then he began a twenty-five-minute labor that left him a chrysalis. He worked so violently at times that it seemed he must fall. Here we will leave him, to detail later the method of a slower, better actor.

AUG. 5. Tiger is a normal, brown, motionless chrysalis. The eye-spots of last night have vanished. I mention a singular thing; I put a finger near, without touching Tiger, and he jerks violently as if to ward me off. Somehow he saw!

AUG. 6. Chrysalis stiff. I safeguard it under natural conditions of heat and moisture. I go hunting and find a one and one-eighth inch Tiger larva on bird cherry. His false eye pattern varies slightly from Tiger I's. He is in his prime and has lost his baby color and tubercles.

AUG. 7. Tiger II hasn't eaten since in custody. Starting at two P.M. his behavior is strange. He heaves with tremendous muscular effort. Perhaps at last I am to see a molt from its onset. Yes, bit by bit the telescoping of the skin begins and grows—wrinkle after wrinkle forms. Tiger II exerts himself with

". . . HE ADDS COUNTLESS STRANDS . . .

HE WRIGGLES THROUGH THE LOOP"

more abandon than Tiger I ever did, but extracts himself from his casing in the same way, even to having his mask stick half way down his face. As before I try to help but the mask does not yield. I try at intervals and finally it drops at a touch. I suspect that the spinneret cases loosen with difficulty. In about fifty minutes Tiger crawls from his discard. He shakes his hindbody to right, then to left, relievedly, making sure he is free. He wags again, joyously this time, and moves blithely forward on his carpet only to set his brakes for a protracted rest. The big thing to me is that he registered emotion—joy.

I retrieve his mask and find it the same size as Tiger I's fourth. It is a clue. He will not molt again until he becomes a chrysalis, and, if there is a set schedule, he will hang on August 18. We shall see.

AUG. 10. I offer Tiger fresh lilac and fresh wild black cherry. He ignores the lilac but after mute protest eats twice during the day of the wild black cherry. He is dissatisfied and wanders down to the pasteboard tumbler-cover, hunched and disgruntled—all symptoms of tummy-ache. Now I assert that a hunger strike is truly a wormy trick but I capitulate and go after the distant bird cherry. My food faddist contentedly accepts it. He knows what he wants.

"TIGER IS A NORMAL BROWN CHRYSALIS"

AUG. 16. Tiger II behaves normally and grows large. I give him fresh bird cherry. He has an uneasy spell but finally starts a new home site.

AUG. 17. I garden near the lilac and see two fresh, half-eaten leaves on the ground. Tiger being indicated, a hunt begins. A shadow darkens a leaf far above my head. My hoe pulls down the branch and I beam on Tiger III. He is as long as Tiger II, but of greater girth. He has a yellower-green skin, a deeper-yellow collar line, and wider spaced eye-spots with minor differences in details and expression. It seems to confirm my growing notion that eye-spotting might be equivalent to finger-printing.

My prize soon basks near Tiger II, in the sanctuary. This Tiger III is oddly thin-skinned. What is this visible forward pulse that surges where a vertebrate would lodge a spine? He is indeed a revealing fellow to show what I had never expected to see in operation—the marvel of a Tiger's larval heart beating rhythmically. (Note: I have since had another such.)

AUG. 18. Due to hang, Tiger II eats instead, proving the life schedule varies, but, significantly, he fails to chew off petioles. Tiger III, now accustomed to surroundings, is again interested in food.

AUG. 19. A day late, Tiger II darkens and mottles, turns brown, is boxed up, travels, and hangs. Seven-forty A.M. saw the start of the change, eight-thirty P.M. found him hanging—on the oblique twig. A long day of work!

The habitually wasteful Tiger III gnawed off a half-eaten leaf in the night. He foregoes food until six P.M. when he nibbles, goes back to bed, and then decides on a dessert course.

AUG. 21. Tiger II became a chrysalis between midnight and five A.M., hanging in his caterpillar skin more than twenty-seven hours.

Tiger III has neglected to chew off two partially-eaten leaves and he turns dark this morning. By noon his bodily preparations are ended and he becomes vagabond. He is a livelier shade than the others. The lens turns his central mottlings into brown lace over green. Caged, his treadmill trek halts at seven P.M. on the oblique twig. I remove the net to watch. This slow motion artist is to divulge family secrets.

He spins a bit, reverses, and spins an extensive tailhold. He turns about and spins where the loop is to be, reaching far around and fastening silk carefully. He is most indolent but thorough. Again he turns about and this time spins the customary snag. Laboriously he turns and vainly feels for it with his tail. Since it eludes him, he must find it with his head. It means another full turn for our elephant-on-a-log, but his next try meets better luck. He pinches the snag repeatedly with something like spite. He rests a while and begins his noose about nine P.M. He has trouble making the silk cohere. Freshly-spun silk is liquid; I think he is so slow it dries too much to stick easily. He goes over it again and again. He makes twenty-nine complete circuits and countless additions at the terminals. Very tired he slides through the finished loop at nine-forty P.M. and contracts. Since noon he has shrunken from two to one and nine-thirty-seconds inches.

AUG. 22. After twenty-four hours' sleep Tiger shivers once and dozes off again. Ten minutes later he quiets a shudder. Soon a faint breathing motion begins. "Tige! Tige! It's ten P.M.! Bestir yourself!" I fume. (Be it recorded that many times before his transformation I remonstrated with him in ungentle terms but he made no haste regardless. Sleepy, I yawned, nodded, roused, sputtered, stuck it out, and triumphed at last.) Eleven-forty-five comes, he merely lengthens himself and makes inner adjustments. Segments five to nine are especially distinct and separate, with deep grooves between. Twelve-thirty comes. Tiger's half-hearted tremors will never split his skin! Impatience nearly bursts mine instead. "Come on, Tige, you putter!"

At twelve-forty-five he sets up a different motion; tail segments come to life. Now he flattens himself, sides curiously angular, and, behold, a whitish wrinkle appears along his spiracles. Moderately, with difficult labor, Tiger writhes within his loosening skin and plainly shoves it

backward. Then he extends his head, stretching the skin of his thorax and tearing a placket as far as the sling; no farther. His chrysalis head emerges where his caterpillar head had been. What a sight! It is so very like a butterfly's head this minute! But Tiger retracts it and the resemblance vanishes as weirdly as it came. Now the split skin is sliding readily but not swiftly backward. Tiger actually pumps it back! The ridiculous ebb of his true-legs is a memory to store-in-laughter.

Tiger's puckered skin reaches the tail anchorage. He deftly withdraws his chrysalis tail and takes a new grip on the snag. Spiral tail writhings drop the old skin, with mask attached this time. It is twelve-fifty-two A.M. of a new day, Aug. 23. Tiger's pale brown chrysalis, with eye-spots showing, contracts to one and three-eighths inches. Raised and shining jet points replace his decorative dots. A greenish color overlies his prominent spiracles. He varies from the others.

Shortly after one o'clock the vigil is over. I plod happily off to bed, half-expecting to dream of Tiger's empty true-legs ambling resignedly off to the discard.

AUG. 23. Daylight. Tiger III's chrysalis is darker and has "jelled". The eye-spots have vanished as they always do, but some pixie brush full of emerald has trailed across all the little peaks and ridges, leaving me the most beautiful chrysalis I have ever seen.

SEPT. 7. The last Tiger Swallow-tail butterfly of the season loiters alone in the garden. Set in direct sunlight my chrysalides wriggle and sway a bit.

SEPT. 17. No hatch in prospect, I put the Tigers in cool, moist storage to await spring. It has been strange to learn that caterpillars have emotions—strange to find lazy ones, energetic ones, wasteful ones. I had not been seeking anything resembling personality; anything anthropomorphic. But I record such findings. If, some time, a National Butterfly is chosen, may it be this individualist known from coast to coast.

"I HAVEN'T THE HEART TO DENY LIFE AND LIBERTY TO EVEN THE LAST OF MY BEAUTIES"

FALL—WINTER

MAY 25. A new springtime. One of their kind inspects the garden, so I bring the chrysalides to a warm room.

MAY 27. Tiger III hatches—a male of four and one-fourth inches wing spread. Released at four P.M., he soars up, up, over the towering maples, earthbound no more.

MAY 29. This morning Tiger II, a lady, hatches. True female, she limbers up her tongue. Wings developed and spread give the readiest key to sex, for Madam Tiger has more blue on her hind wings than has her husband. She, too, is released.

JUNE 1. Tiger I, hatching before eight A. M., is also a female with four and three-sixteenths inches wing spread. I haven't the heart to deny life and liberty to even the last of my beauties; for Tigers are not butterflies, they are symbols—symbols of ultimate survival and of victory—symbols of an over-law at work today as it was in the countless yesterdays.

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Audubon

By MILDRED SIMMONS

He wandered in the wilderness with stone
His pillow; through the marsh-land deeps, alone,
Where birds cried out above the sighing reeds,
And sea winds carried salted spray. His needs
Were second to his art—Through field and wood
He caught the whir, the flash of wings and stood
In silence, till the perfect forms were caught.
Sweet birds, whose colors by his skill were wrought;
Birds natural as though one's eyes could see
The heaving breasts. With what deep ecstasy
He sacrificed and toiled. Long days were spent
In watching, praying, till with heart content
He gave the world a treasure, priceless art,
The cherished work of brawn, of life, of heart.

The Joshuas of Antelope Valley

By FLINT HINDMAN

A MAGNIFICENT SPECIMEN OF JOSHUA TREE
Fan-shaped and unusually luxuriant in its branching, this tree stands thirty-four feet high, and measures forty-eight inches in trunk diameter

HOLD the globe of the world in your hand and discover where the Joshua tree grows. Asia, Europe, Australia—none there. Spin the Americas around and your search narrows. Now you are looking at North America. Your finger pushes from the eastern seacoast toward the western deserts. As it moves across Utah into Nevada it touches a straggling Joshua or two. In California's Mojave Desert the grotesque trees grow larger and more numerous. It is here, finally, that you find the most gigantic specimens that the world knows—the Antelope Valley Joshua trees.

There are not many. The diminishing forest of them stands on just 240 acres, unprotected, uncared for. The land is deadweight on the hands of owners who bought it for oil rights. They would sell it quick for $15 per acre. Fortunately it is deep in the desert, or the Joshuas would long since have been sacrificed to alfalfa fields.

Lone survivors of that prehistoric age when tropical flora matted the western portion of the United States, these giant Joshuas may not outlive the Twentieth Century. Unwittingly civilization is their executioner. The same indifference that wiped the buffalo from our plains is denuding our deserts.

In Antelope Valley, irrigation has sprung a beard of green about the jowls of the desert. These Joshuas stand on the patch of desert that stretches tautly from the last emerald wedge of alfalfa, out beyond to the western foot of Saddle Butte. Here, before the white men came, Piute campfires used to glow. The trees we see still rising nobly above the shaggy chaparral are scarcely larger than they were when the Indians used them for shelter.

They grow with infinitesimal slowness. Redwoods increase an inch in diameter every twelve years. Scientists have observed Joshuas for twenty years, watching for a change and finding none.

Some Joshua trees, *Yucca brevifolia,* antedate recorded history. Trees live to hoary, incredible age. Seedlings that were struggling with the desert when Joshua, the Israelite, was invading the borders of Canaan, may be the granddaddy trees of today. The devotional resemblance of their twisted branches to the upflung arms of the Biblical Joshua suggested this name to the Mormons on their desert trek, and so the trees are known today.

It is difficult to judge the age of Joshua trees. The trunks afford no annual rings to serve as growth calendars. In fact, their trunks are quite hollow, the living tissue being absorbed by growth. They propagate both by shoots and seed, and are known to send forth subterranean lateral stems that sprout new plants although these are generally the result of an injury to the main trunk. The cordlike roots, about the thickness of lead pencils, run into the soil for great distances seeking moisture.

Joshua tree architecture, that weird grotesque pattern that catches the imagination of the desert traveler, is due to erratic growing habits. First, one must remember the tortured slowness of growth, and that a seedling Joshua

A TYPICALLY BATTERED JOSHUA TREE
This is a forty-one-foot giant among its kind and Joshuas of this size are not common outside the confines of Antelope Valley

grows to a height of eight or ten feet before it branches. Spiny leaves cover this shaft, so it looks like a giant yellowish-green bottle brush stuck up among the chaparral. The tree is already old, and yet it has not bloomed and has no branches.

Once the first blossom appears, the Joshua is on its way to becoming a real tree. The blossom dies and two branches begin to form at that junction. These, in turn, blossom and divide, and the arithmetical progress continues through the centuries.

No two Joshuas are alike, for the blossoming and division is highly irregular. Sometimes, the flowers do not appear for many seasons; therefore, no progress in growth has been made. The blossom is the triumphal banner hoisted by the tree when its search for moisture has been rewarded.

Some indirect factors take toll from the Joshuas. Half a century ago, a cargo of Joshua trunks was shipped to England and converted into excellent paper. One issue of a newspaper was even printed upon it. Fortunately, the venture proved unprofitable. But think of the centuries that were pressed together in a single sheet of that paper! Later, trunks were shipped to Los Angeles and shaved into thin strips, which were used as protectors for small, newly-planted fruit trees. They were valuable, being sun and rabbit proof. A humane use is for surgical splints. The wood is light and extremely stiff, and its porous composition allows free circulation of air over the splinted area.

California values its disappearing Joshuas more lightly than does England. Kew Gardens of the British Isles owns a Joshua valued at $100,000, if it has escaped bombs. A curious legend is wound about this exile tree, whose massive branches are held up by chains. A superstition has it that the Royal Family will suffer a major catastrophe should one of the branches fall to the ground—hence the chains.

Once there was a very old Joshua even more massive than this guarded specimen in England. Known to thousands as the "grand-daddy of them all," it grew beside the road leading to Roosevelt, California. A party of sightseers came along, stopped to see the tree, and goaded by a maniacal urge, doused it with oil and left it to die in a holocaust of flames.

The vandals were never caught. Even had the reward offered by the International Desert Conservation League been paid out and the vandals punished, "grand-daddy" could never be restored to a venerating world.

All this is why the Joshuas are vanishing.

If the wood is required for surgical splints or for the manufacture of novelties, conservationists ask that small and less perfect trees be selected instead of the giants who have won the right to survive as showpieces of Nature. But in any case, every tree chopped down *should be replaced by careful planting*—but why cut them down?

More than a dozen years ago, a group of conservationists started a fight to save the Antelope Joshuas from possible exploitation, and from other threatening dangers. The first letter addressed to the Los Angeles County Board of Supervisors was signed by the Joint Parks Committee. Since then, the plea has been handled by various groups.

A joyful victory was won when Los Angeles County budgeted a sum for the purchase of the land as a park. But the victory crumbled as the money was little by little spent on other ventures until today it has dwindled to a barely sufficient $4200.

The County of Los Angeles still shrinks from the prospect of maintaining the land as a park, although conservationists plead only for the county ownership of the land. Then, at least, vandals could be intimidated. Upkeep? Major Harry L. Bateson, scientist, horticulturist, and Joshua sympathizer, has offered to inspect the trees free and to assist in their artificial pollination.

But the land has not been purchased. The State of California hints that it might accept the land as a gift from the County and maintain it as a national monument. One of California's representatives in Washington waits to present the problem for Federal solution.

The years roll on while the welfare of the world's most splendid Joshua grove hangs in the balance, the

A JOSHUA LANDSCAPE
Seen on the horizon, these trees are not unlike praying figures extending beseeching arms to the heavens

grove of which the landscaper, Frederick Law Olmstead, said:

"When last seen I rated these trees among the most notable specimens remaining in the United States and greatly worth preserving."

A growing legion of Nature conservationists take up the prayer of the vanishing forest—begging, pleading for a government subsidy to rescue it for the generations to follow. These Joshuas lived before we came, and they should live after we have gone.

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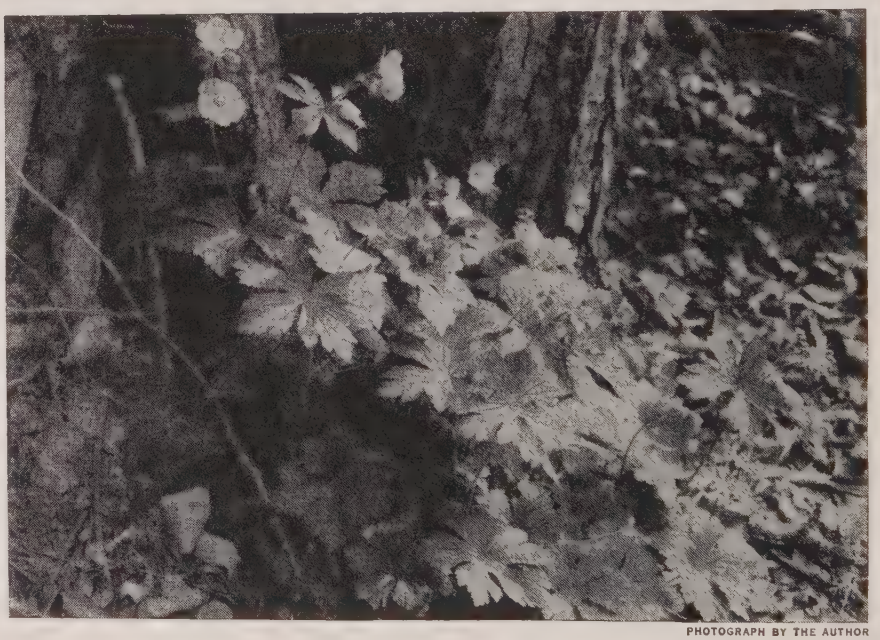
The Wild Cranesbill

By WARREN C. WILSON



PHOTOGRAPH BY THE AUTHOR

Did you know that the common house plant called geranium is not a member of that genus? The botanists place it in *Pelargonium.* But it and our wild or spotted cranesbill, a true *Geranium,* belong to the same family. *Geranium* is an old Greek name for the crane. The long fruit-bearing beak was thought to resemble the bill of that bird.

Geranium maculatum is a vigorous-growing perennial. It often attains a height of two feet or more. Both the stems and foliage are hairy. The flowers produced over a rather long period in the spring average about an inch in diameter. They are usually light rose-purple, but rarely one finds a white form. The leaves have five lobes and distinct veins.

If one does not object to its size and vigor, the wild cranesbill makes a desirable plant for the wild flower garden. It grows from Maine to Manitoba and south to Alabama at the edge of woods or in open woodlands. The plants grow in poor, stony soil as well as in richer, organic soils, and will come up each spring for years.

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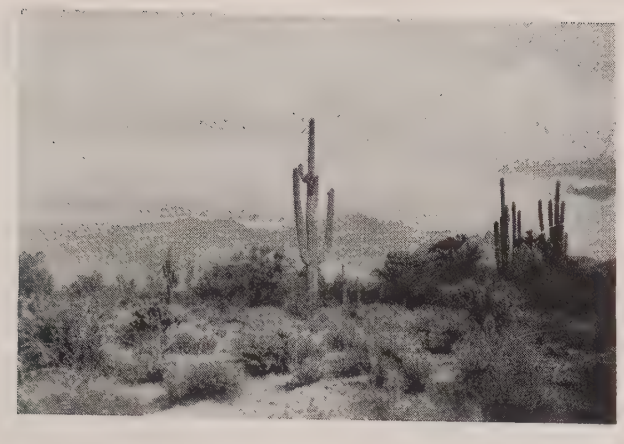
EARLY HERALDS

By LOUISE LEIGHTON

The twilight lengthens through the north;
In flocks, the juncos wheel and dart;
The flowing masses of the ice
In tinkling sapphires break apart.

The willow boughs are gleaming brass;
The clouds take wings; they soar and fly;
The old delight steals through our veins
And spring rides down the frosty sky.



Swift Desert Beauties

Some of the interesting lizards of the arid Southwest

By JOSEPH R. SLEVIN

IT IS ONLY recently that the public has awakened to the fact that our deserts, once considered barren wastes to be avoided, are really regions including some of the nation's wonderlands, and are recreation grounds for the tourist and fields of study for naturalist, artist and photographer.

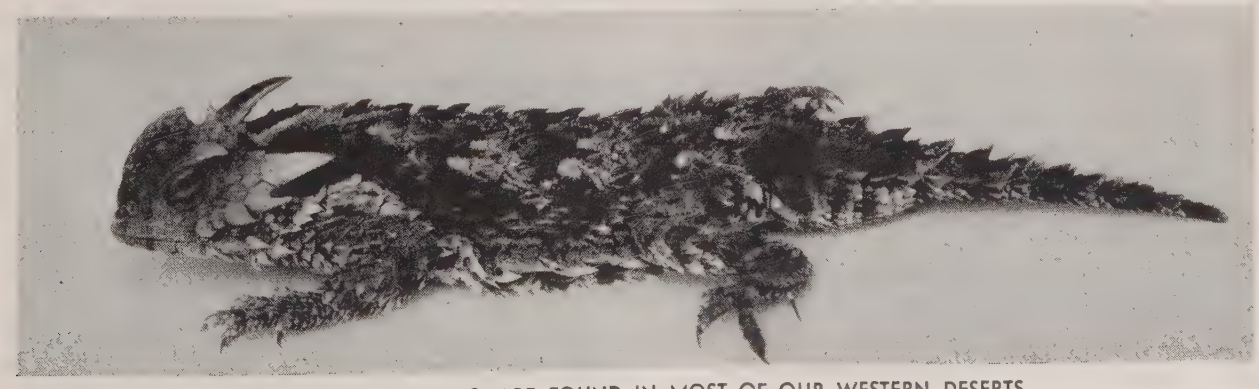
From the standpoint of the naturalist, of course, they have always been of fascinating interest. Deserts are regions that demonstrate how Nature protects its living creatures and forms them to fit the environment in which they live, equipping them to protect themselves from their enemies, and to live under most rigorous climatic conditions.

The casual visitor will wonder at the giant cactuses of the mesas and rugged canyons of the desert mountains, and possibly take notice of a wandering coyote or some of the more conspicuous of the birds. However, one of the most characteristic groups of animals, and one which only the more observing visitor—one really knowing something of Nature—will be able to study, are the lizards, whose true home is the desert.

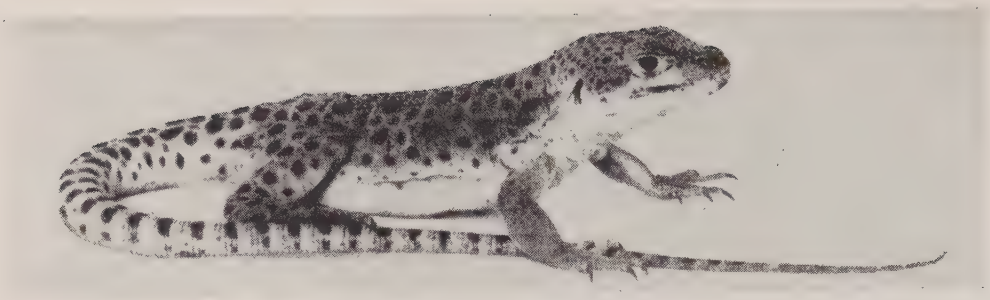
To deal with the reptile life of the desert would require volumes, so we must confine ourselves for the moment to some of the more interesting animals among the great variety of life spread over the desert sands of the Southwest. Those who are really interested in Nature do not need its spectacular and stupendous creations to attract them, and desert lizards merit neither adjective.

Even to treat of all of the lizards would be a long task, but meeting a few of these fascinating creatures may stimulate further acquaintance with these true denizens of the deserts. The observer must first choose the proper time of day. This is between sunrise and midday. Although the desert lizards enjoy a certain amount of heat about noon, and during the hottest part of the afternoon, many of them seek cover from the intense rays of the sun. They may either retire under ground, or bury themselves in the loose sand around the roots of bushes. There the sun will not shine directly on them. A few species are nocturnal and are seldom, if ever, seen in the daytime.

Despite the fact that in certain areas lizards may be found in abundance, time is really necessary to make a success of studying them under natural conditions. Meeting the lizards may be for mere pleasure. Or, better, it may be for photography, and the camera enthusiast will find no sterner challenge to his skill, because the lizard is a difficult subject to handle. By nature a wary creature, it must be approached with caution. Motion, not noise,



HORNED LIZARDS, CALLED HORNED TOADS, ARE FOUND IN MOST OF OUR WESTERN DESERTS
They are slow-moving compared to other desert species, but have a novel defense in their crown of sharp-pointed "horns," making them no dainty morsel for a hungry snake



THE LEOPARD LIZARD

It takes its name from its leopard-like spotting. It has great speed, a powerful build and a muscular jaw that throws terror into its weaker prey

THE CHUCKWALLA

This lizard feeds on the tender shoots and blossoms of desert vegetation. While it has strong jaws and is powerful, it will not bite or struggle in the hands of its captor

NORTHERN CRESTED LIZARD

It is also known as the desert iguana. This lizard is a vegetarian, and is extremely docile, lacking the aggressive disposition of the leopard lizard. It will never offer to bite

will send the lizard off like a shot, and once this individual is really scared, there will be no use in chasing it. Another subject will have to be found.

One of the most spectacular lizards of the desert is the leopard lizard, *Crotaphytus wislizenii,* the common name from its spotting. It is a ferocious creature with long powerful legs and muscular jaws able to crush the bones of its prey. A large specimen will reach a length of thirteen or fourteen inches. It is a marvel of speed, and has to be in order to capture its food and escape its enemies, one of which is the red racer, a large and speedy desert snake. The leopard lizard feeds on such other lizards as it is able to catch and kill by virtue of both its power and speed. One of its favorite foods is the desert whiptail, *Cnemidophorus tessellatus,* a graceful and speedy lizard, but less strong and muscular than its enemy.

Leopard lizards occur both on the open mesa and in the dry washes, where one may be seen standing in the shelter of a bush or rock, stretched to its full height, intently watching for some unsuspecting victim to pass its way. Woe be it to the one that is unfortunate to come within its vision! It will start for its prey as if shot from a gun, never slackening its speed as it grabs its victim by the head. However, as with other members of the animal kingdom, it is a case of the survival of the fittest, and the leopard lizard itself must always be on the alert for a possible enemy, whether a hawk or the red racer. At the sight of an enemy it will dash off with incredible speed, seeking the safety of some nearby hole beneath a rock or bush, and seeming always to be within reach of one. The pursuer has to be a real speedster to catch the leopard lizard, for seldom will it be taken unawares.

During its breeding season this lizard has few rivals for beauty, both in color and pattern. The ground color may be either buff, light yellow, or purplish, ocellated with large spots of brown and red and sometimes barred with creamy white. The under surface is dull white, with blotches of brick-red.

Another lizard of about the same size is the northern crested lizard or desert iguana, *Dipsosaurus dorsalis,* also an inhabitant of the open mesa, but of an entirely different disposition. It is readily distinguished from the leopard lizard by its short head, and by the scaly crest extending along the back and tail. The desert iguana is a vegetarian, and although it may occasionally be seen on top of a cactus leaf eating a freshly opened bud of the *Opuntia,* or some other desert plant, it is more often seen on the ground close to some shelter, where it can seek refuge from a possible foe. If captured and held in the hand it will not offer to bite like the leopard lizard, which will have its mouth wide open ready to grab whatever comes within reach. It is of a somewhat somber color, having dull reddish markings over a ground color of creamy white.

One of the most abundant lizards on the desert, and a much more graceful one than the former two, is the desert whiptail, *Cnemidophorus tessellatus,* so called from its long slender tail. Its whole makeup suggests speed, and

SHORT-NOSED LEOPARD LIZARD

This one bears the typical spotting and has a series of cream-colored cross bars. When standing, with its front legs stretched to full length, it presents a picture of alertness and undeniable grace

DESERT WHIPTAIL

This fellow is exceedingly restless and gets its name from its long, tapering tail. Speed is its only means of defense, and it is truly streamlined for this

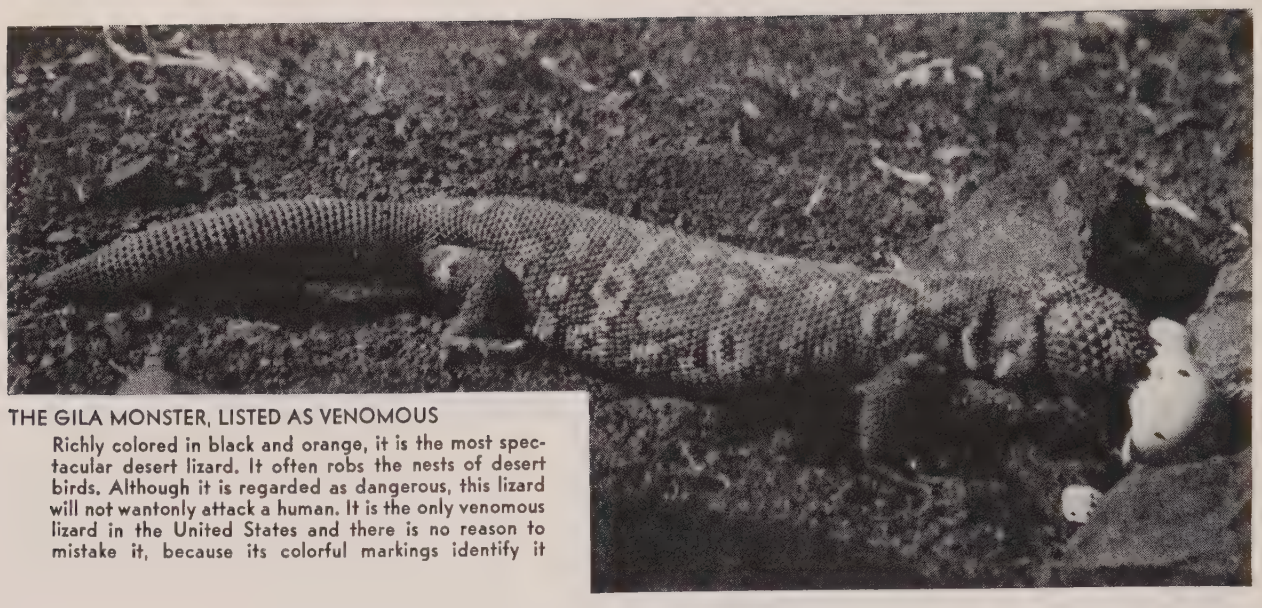
this is its sole means of protection. The desert whiptail is an insect feeder, and, like the leopard lizard and desert iguana, is an inhabitant of the open mesa, although it may be found in the dry washes, or even in the gardens about the outskirts of the desert towns. It is an extremely restless creature, never remaining still for any length of time. Like all other lizards it is constantly on the lookout for some prospective enemy. However, when not alarmed, it may be observed moving about with a short jerky motion as it seeks its food amongst the desert plants. In certain areas where the growing of alfalfa is undertaken it has been found to be a great destroyer of the alfalfa weevil, and, consequently, quite an asset to the farmer. The color pattern of the desert whiptail varies considerably, having stripes and reticulations over a brownish or yellowish ground color. Only a few species are strikingly colored.

Differing somewhat in structure from the three former species, but similiar to each other, are the ocellated sand lizard, *Uma notata,* and the desert gridiron-tailed lizard, *Callisaurus ventralis.* The latter is found on the open mesa, in the dry washes, and the sandy areas, while the former is closely associated with the rolling sand dunes only. To elude an enemy they will start off with surprising swiftness, follow an arc for twenty or thirty yards in their flight, and stop with equal suddenness, thus throwing their pursuer off the track. Their bodies blend so perfectly with the surrounding sands that they defy detection. It is only the experienced eye that will be able to detect the gridiron-tailed or the sand lizard once it has made its first run from supposed danger. Like many other lizards the gridiron-tail is highly-colored during the breeding season. The back is gray, mottled with white. The under parts have a ground color of pure, dull white, the tail being barred with black, and it is from these bars that the lizard gets its name. The sides of the belly have two black spots or bars on a ground color of green.

The sand lizard is beautifully ocellated with minute spots of green, black, and red, on a yellowish or buff ground color. The under surface is similiar to that of the gridiron-tailed lizard. A closeup inspection of the foot will reveal a scaly fringe on the fingers and toes, helping the lizard to get traction on the loose sand.

Characteristic of our deserts is the chuckwalla, *Sauromalus ater,* an inhabitant of the boulder bluffs, and the largest of Californian lizards. It will be found sunning itself on the top of some huge rock, and always in close proximity to some crack or crevice, into which it retreats at the first sign of danger. When the lizard is safe inside, it fills its lungs with air, wedging itself between the rocks so that it is extremely difficult to dislodge. The chuckwalla is a vegetarian, living on the blossoms and tender shoots of the desert plants. The Indians formerly considered this lizard quite a delicacy and persistently hunted it for food.

Any mention of desert lizards must of necessity include the Gila monster, *Heloderma suspectum,* sometimes called the beaded lizard from the texture of its skin. It has the distinction of being our only venomous lizard. Supplied



THE GILA MONSTER, LISTED AS VENOMOUS

Richly colored in black and orange, it is the most spectacular desert lizard. It often robs the nests of desert birds. Although it is regarded as dangerous, this lizard will not wantonly attack a human. It is the only venomous lizard in the United States and there is no reason to mistake it, because its colorful markings identify it

with grooved teeth and poison glands in the lower jaw, which secrete venom potent enough to kill small mammals, it has earned the distinction of being the most feared of the desert species. Actually it can hardly be classed as dangerous, as it would never attack or bite a person unless provoked to do so. Despite the fact that it is generally slow of movement it can turn its head and bite with lightning-like rapidity, and holds on with a bulldog grip. It is a robber of birds' nests and is known to eat the eggs of the desert quail and other ground-nesting species. Its rich coloring of black and orange is in striking contrast to the surrounding country in which it is found, and therefore it is a conspicuous object.

Gila monsters average about nineteen inches in length, although specimens several inches longer have been taken. They are found in the desert regions of southern Utah and Nevada, Arizona, western New Mexico, the valleys of the Gila River—appropriately enough—and its tributaries, and in Sonora in Mexico. In some specimens of the Gila monster the paler hues will predominate, while in others the black is most pronounced. Large, soft-shelled eggs are deposited in the sands of the desert.

Fortunately for the lizards themselves, most of them are passed by unobserved, and consequently have escaped the shameful slaughter of their less fortunate brethren in the animal kingdom. But the Gila monster, since the advent of the automobile and the desert highway, has suffered to some extent because it seems to be a popular idea, or at least has been, to destroy all animal life, especially a venomous reptile.

Let us hope that the desert tourist will not exterminate this interesting animal, and remember that even the lowly lizard has its place in helping to keep what we are pleased to call—and ignore—the Balance of Nature.

GRIDIRON-TAILED LIZARD (ABOVE) AND THE OCELLATED SAND LIZARD

The former is colored to blend with surrounding sands and only the experienced eye can detect it once it has made its run. The fingers and toes of the sand lizard are specially adapted for running over the loose rolling sands and are fringed with long and pointed scales to allow the lizard to get traction

RECIPE FOR HAPPINESS

By JOSEPH G. LEVINE

Photograph by Jean Hersey

Select a large dome-shaped bowl, translucent and turquoise blue like the sky. Invert the bowl.

Within the bowl spread large quantities of mountains, valleys, canyons and mesas. Heap up peak after peak, each wrapped in a veil of violet. Mix well.

Pour in the gold of flaming sunsets. If your spoon happens to catch a rainbow stir it in. It blends perfectly.

Add a good measure of sun-kissed plain, salty in flavor. Bristle with cactuses—like prickly pear.

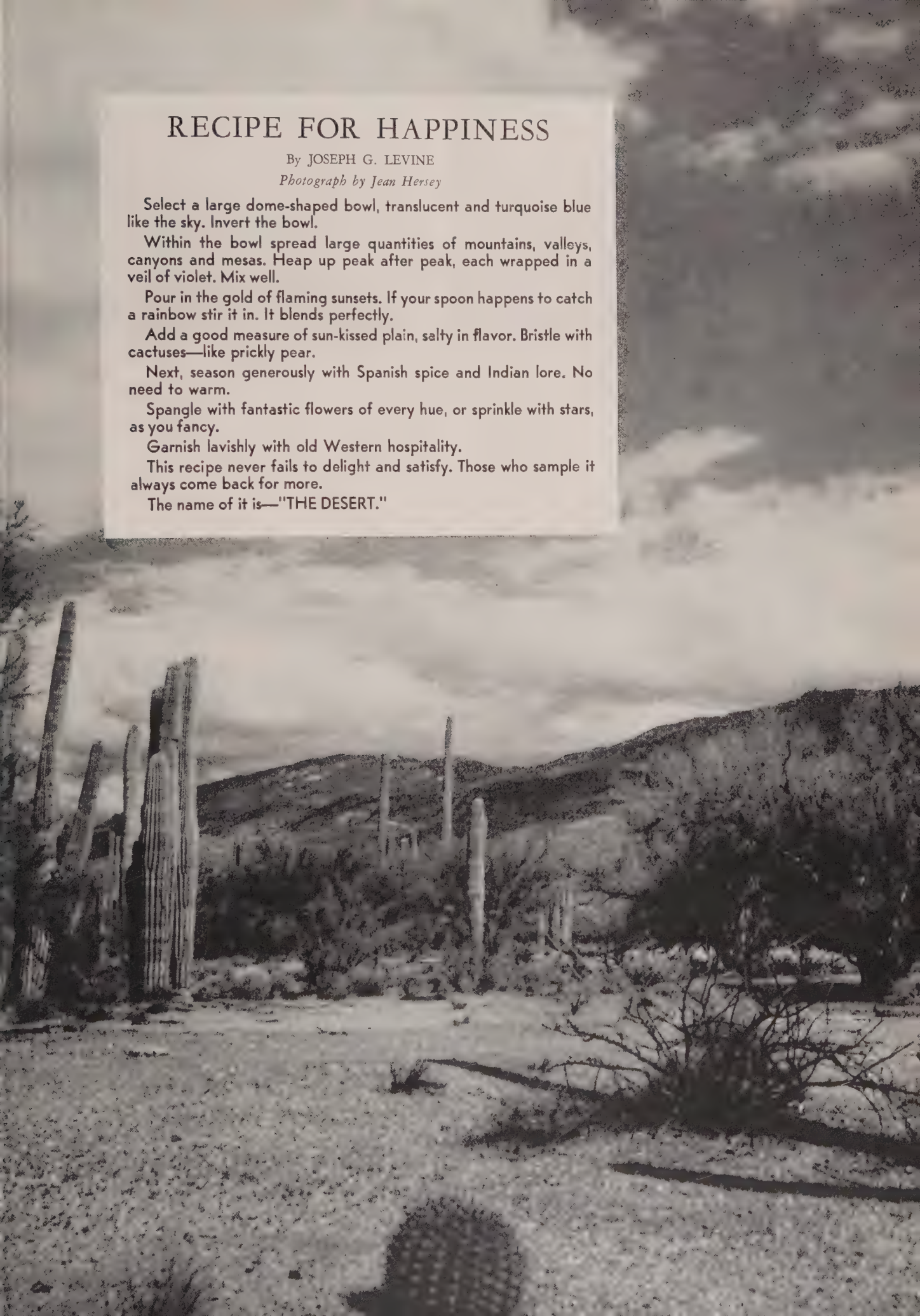
Next, season generously with Spanish spice and Indian lore. No need to warm.

Spangle with fantastic flowers of every hue, or sprinkle with stars, as you fancy.

Garnish lavishly with old Western hospitality.

This recipe never fails to delight and satisfy. Those who sample it always come back for more.

The name of it is—"THE DESERT."



WHEN THE FOREST GREW

WHEN THE FOREST WAS BURIED

A FOREST TURNED TO STONE

By M. V. WALKER

Photographs courtesy of The National Park Service

THOSE WHO travel in the arid Southwest are often surprised to hear the people of Arizona boasting of their great forests of virgin yellow pine, with their many board feet of fine marketable lumber. They are even more surprised to hear the people of Arizona boasting of their petrified forest, where the trees have all been changed to stone, and where the timber is not reckoned in board feet, but is measured "per carat". This "stone" forest has become an almost priceless collection of semi-precious stones—agate, carnelian, amethyst, jasper and onyx.

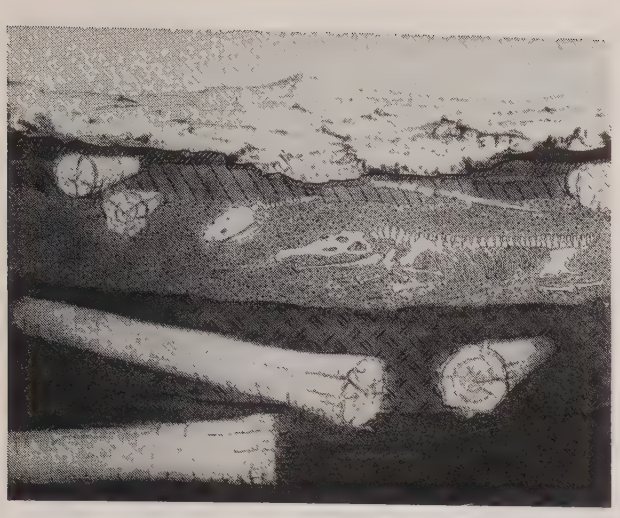
The great desire to tell the story of the petrified forest to the folks from back East has resulted in many fantastic stories concerning the origin of this interesting place. These stories have grown with the years, and it is not uncommon to find such statements, fabricated by an untrained observer, passed on and finally printed in some of our leading travel books and touring guides. For example, one publication informs us "that the glaciers killed the forests". Another says "that an ocean buried the forest", and still another asserts "that the trees did not grow where they are found today, but were drifted in from a distance". Recent researches have proved beyond a doubt that these three statements are all in error.

The United States government early recognized the great scientific value of these petrified forests, and years ago (1906) set aside a small part of the area as a National Monument, to be called the Petrified Forest National Monument. There have been a number of boundary changes and additions since that time, and at the present time (1941) the Petrified Forest National Monument comprises some 90,000 acres, the latest addition being the Black Forest area in the Painted Desert section, which is north of U. S. highway 66.

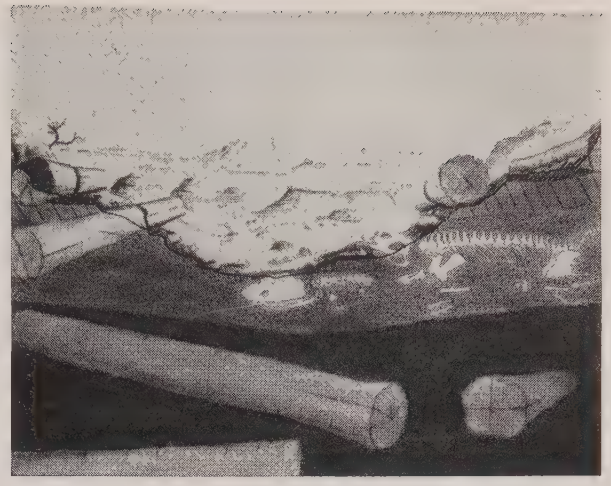
It is true that there is some petrified wood scattered over the entire 90,000 acres, but there are certain areas where it is abundant enough to be called a forest, and for that reason the forests of the Petrified Forest National Monument have been named as follows: First Forest, Second Forest, Third Forest, Rainbow Forest, Blue Forest and Black Forest.

"OH! RANGER. WHO SAWED THE LOGS?"
This question has been asked by visitors to Petrified Forest National Monument and the only answer is that Nature and the ages are responsible for these creations

For many years the Petrified Forest National Monument existed in name only, and only since about 1929 has the monument had a resident government man to administer the area. Since that time, the area has been developed rapid-



WHEN THE FOREST WAS UPLIFTED



WHEN THE FOREST WAS UNCOVERED

ly, and now the National Park Service has assigned a number of permanent rangers and naturalists to the area for the purpose of protecting, preserving, studying and explaining the petrified forest. More than 200,000 persons visit the monument each year and demand to know the why and wherefore of it all.

Since it is impossible to explain to each individual the step by step story, the National Park Service has constructed a museum building and installed charts, drawings, and text labels, prepared under the direction of trained geologists and paleontologists, to tell the "true" story of the Petrified Forest. This account is the result of years of research by specialists, who have recently made some outstanding discoveries in the very heart of the Petrified Forest National Monument.

In Triassic time, 150 to 200 million years ago, there existed in western North America a great low-lying valley. This valley covered what is now the western part of Texas and New Mexico, northeastern Arizona, eastern Utah, and a great arm extended as far north as central Wyoming. It was bounded on the east by the ancestral Rocky Mountains, and on the south and southwest by another low range of mountains. A low flat plain stretched northwestward to the Pacific Ocean, for the great Sierra Nevada and Cascades had not yet been uplifted. This old valley was not far above sea level and numerous sluggish streams probably flowed across it and emptied into large brackish lakes, which were scattered throughout the valley. On the land areas grew forests of Araucarian pine trees, jungles of ferns, and dense thickets of giant rushes (neocalamites), while in the streams and lakes and along the marshes lived large reptiles known to scientists as phytosaurs and anomodonts, and amphibians that have been called stegocephalians.

The higher land areas to the south and southwest apparently received quite heavy rainfall at certain times, and the streams then became rushing torrents with sufficient volume to carry in great quantities of gravel, mud, and sand. This was deposited in extensive sheets over the low-lying region where the forests were growing. These many-colored sheets of mud and sand were later to become the Painted Desert. Many of the trees along the banks of the streams were caught up by the currents and carried to some small lake or side eddy where they were deposited in great numbers. Other trees along the lakes and streams were water-killed and buried in exactly the place and position in which they grew. The flooded streams often caused the lakes to rise and cover the dense growths of ferns and rushes that grew along their margins, and, as the mud and silt slowly settled, these plants were buried and preserved. This procedure was repeated time after time, for as the valley slowly subsided, and a new forest grew, more floods would come in and cover it, until, finally, some 500 to 600 feet of sediment had been deposited, with the logs and trees scattered throughout the deposit. Even then, the valley continued to subside and more mud washed in until, after a while, some 3000

THE LONG LOGS IN THE THIRD FOREST
The area of the National Monument has been divided into several parts known by descriptive names that suggest the history or appearance of that particular section

feet of mud, sand and gravel covered the area. As a climax to this continued subsidence, a shallow ocean finally encroached and spread over the entire region.

It was after the logs were buried "deep" in the ground, that minerals (silica) in solution in the normal ground water, slowly seeped into the wood, completely saturated it, and replaced the wood fibres cell by cell until the entire tree had "turned to stone". What actually happened was that the minerals simply took the place of the wood, cell by cell, thereby forming a perfect mold or cast of the tree, with such remarkable preservation that we can make thin sections of this petrified wood and study the cell structure under the microscope almost as easily as we can study cell structure in a living tree today. In this way we can identify the type of tree concerned. Other minerals, such as iron and manganese, were also in solution in the water and soaked into the wood, thereby forming the beautiful colors that we now see in the petrified, or agatized, wood.

EAGLE NEST ROCK
This spectacular example of wind and water erosion is found in the First Forest region of the Petrified Forest National Monument

In Cretaceous time, when the shallow ocean covered this region, the old forest was buried to a depth of some 3000 feet. At the end of Cretaceous time, about 90 million years ago, there was a great period of mountain making, and the old Rockies were thrust up higher than ever before. Still later the great Sierras and Cascades were forced up, with the result that the region between the Rockies and the Sierras was lifted several thousand feet, thereby bringing the old forest, which was at one time 3000 feet below sea level, up to an elevation of some 5000 feet above sea level. The petrified trees, however, were still buried deep in the ground, and here they were destined to remain for many more years, waiting for the agents of erosion—the rain and the wind—to carry away the many feet of overlying sediments.

Since the great period of mountain-making, which lifted this region higher and higher and exposed it to erosion, the rain and the wind have been cutting and carving away the mass of mud and sand that once covered the forest. Large rivers were in time formed and their many tributary streams collected and poured in great quantities of soil that finally found its way into the great Colorado River, where it was soon rushed through the Grand Canyon and finally out to the sea. After millions of years of erosion in their surroundings the great logs finally were exposed in the sharp cliffs and canyons. As erosion continued they often rolled from the hillsides and broke into even sections, which accumulated in piles at the base of the cliffs. But the story is not ended, for many more logs are yet buried, some to a depth of 200 to 300 feet. Here they await their time to appear on the surface of the earth, and in turn become objects of awe and admiration.

Thus it was that the forest grew—was buried—turned to stone—was uplifted—and was uncovered—thereby producing a "petrified forest".

•

STUMPS

By L. L. THOMPSON

Stumps are ugly things,
  Tombstones of forgotten trees,
Ghosts of bygone days,
  Embraced by death—eternity.

Stumps are mocking things,
  Of charm and beauty shorn,
Marked by decay and worms.
  Why should stumps be born?

Stumps are sore-like things,
  Scars for passers-by to see.
Past grandeur is forgot—
  I wish stumps couldn't be.

Gas-Plant, or Burning-Bush

By PAUL A. KOHL

Photographs by the Author

There is an old and interesting flower garden subject that is commonly known as the gas-plant or burning-bush. It is unique among garden plants because the flower-clusters will ignite when a lighted match is held to the base of the stalks. The flame is of such brief duration, however, that the flowers are unharmed as it leaps upward. Each stalk is covered with numerous glands that exude a fragrant substance with the odor of lemon. Where these are numerous there is an accumulation of a volatile substance that burns with a flash that is most startling at night.

Fraxinella and dittany are other names by which this plant has been known. *Dictamnus albus* is the only species that normally has white flowers, but there are rose and rose-purple varieties. It is indigenous to a wide area extending from southern Europe to China. *Dictamnus* is an old Greek name that is supposed to indicate that its foliage resembles that of the ash tree. *Fraxinus* is the generic name for the ash, and from this fraxinella is derived. The name dittany is rather unfortunate, as it is commonly applied to *Cunila origanoides*, abundant in our eastern states.

The early herbals do not contain details of the discovery that the flower clusters ignite. Wylliam Turner, as early as 1551, mentioned the "perfume of the smoke," but he may have referred to that of the burnt plants. John Gerarde, in 1597, described and illustrated fraxinella, but said nothing of its inflammable nature. John Parkinson, in 1642, in his Paradise en Sole, fully described fraxinella but made no mention of a flame. However, M. Duhamel du Monceau in La Physique des Arbres, a French publication of 1788, wrote about the inflammability of this plant on a still, sultry evening. Since then there have been numerous references to this phenomenon, and the proviso that the evening be "sultry" has usually been included. This is not true, however, as the gas-plant will ignite whenever it is in bloom, regardless of the humidity.

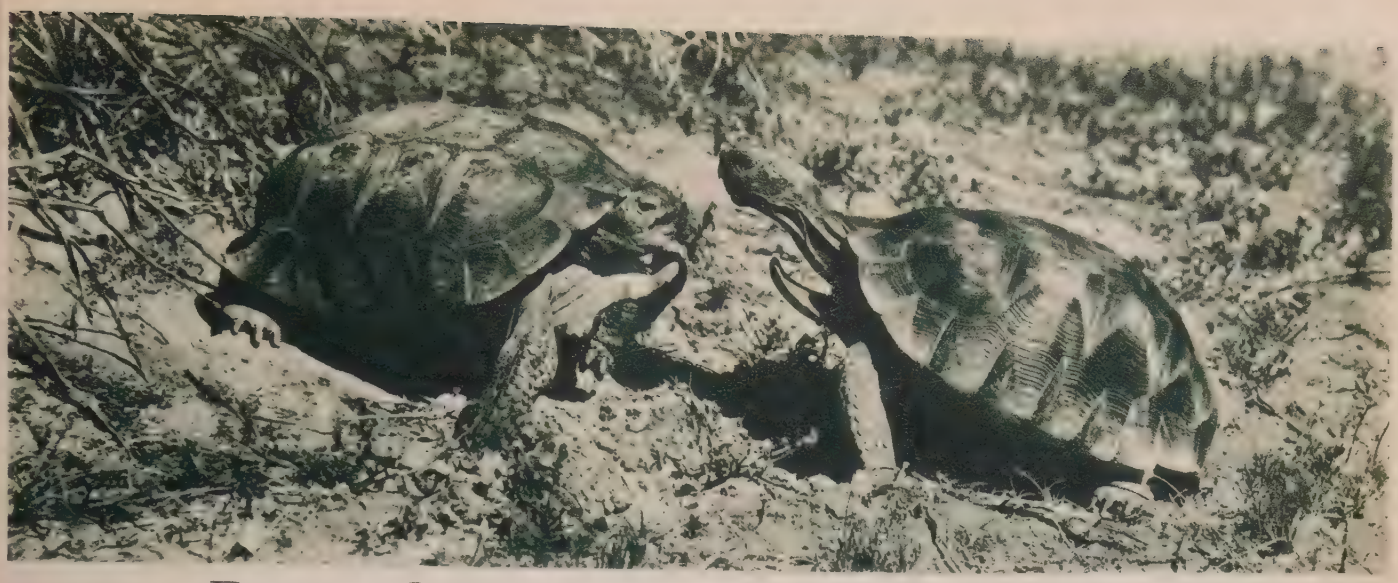
Dictamnus has been grown in gardens for many years, a long-lived perennial that improves with age if undisturbed. It grows to about three feet in a sturdy clump, blooms in May, and the dark, leathery foliage remains attractive during the entire summer. When the star-shaped seed capsules open in

Flame leaps through the flower cluster of the gas-plant. Thus the plant furnishes its own illumination for the photographer. Taking pictures of this unique garden flower furnishes a different sport for the photographer

Seed capsule with the spring-like ejector and jet-black seeds of the gas-plant. Above, right, the five-parted seed capsule with four cells about to disperse seed and the other still closed. Note glands on the stem and capsule. These exude the oils that ignite. At right, flower clusters of *Dictamnus albus*

June and July, each of the five segments exposes an odd-shaped, hooded spring. The tension increases as the capsule slowly expands. Suddenly the spring is released and three shiny, black seeds are shot some distance from the parent plant. The seeds may be sown one inch deep in rows in frames, or in the open, in the fall. No mulch is needed since the frost action is beneficial and aids germination in the spring. After two years the seedlings may be transplanted to their permanent location in the flower border.

Besides being an attractive garden plant, the gas-plant is also an interesting subject to photograph on a still night. A fully-developed flower cluster is selected, the camera set on a tripod and sharp focus assured with the aid of a flashlight. For film of average speed the lens is set at F.8. The shutter is opened, a match is lighted and carefully brought to the base of the flowers to avoid jarring the stalk. After the flame has leaped through the flower cluster the shutter is closed. No two pictures will be alike as each flash of light registers differently on the film.



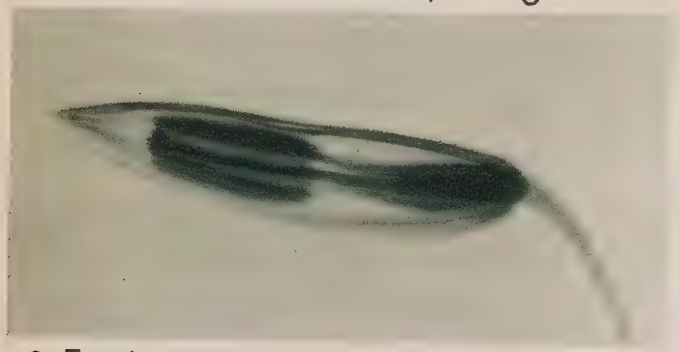
Desert Combat

RECORDED BY JOHN THIEL

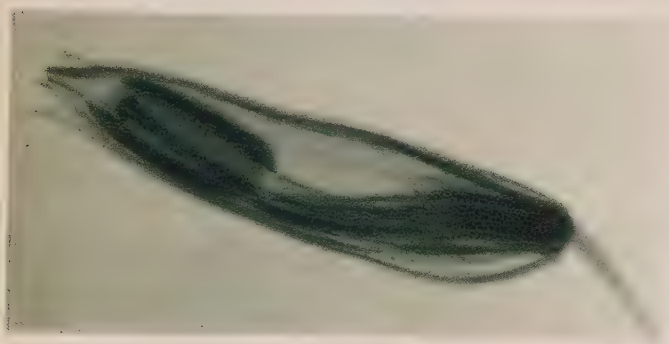
When spring brings color and action to the Mojave and Colorado deserts of the Southwest, the desert tortoise, *Gopherus agassizii*, emerges from hibernation. At this sentimental season the males often are belligerent when they meet. One challenges, bobbing his head up and down. Then both retreat a bit, surveying the situation with heads drawn into their shells. Then comes a rush, each seeking to get the upcurved edge of the forepart of the shell under that of its opponent. With hind legs braced, each seeks to overturn the other battler.

If the victor is still in fighting mood he may not wait for the other to right himself, but helps him do so. During the struggle sounds like panting may be heard. An overturned turtle jerks one leg powerfully in the air, setting up a rocking motion that finally enables it to reach the ground with the other legs. The desert tortoise is a most harmless creature, deserving of the California law that prohibits its commercial use and thus checks exploitation.

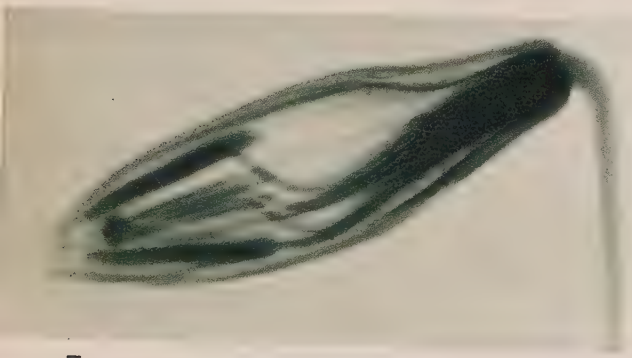
1. Lily bud at an early stage



2. Forty-seven hours later



3. Thirty-four and one-half hours later



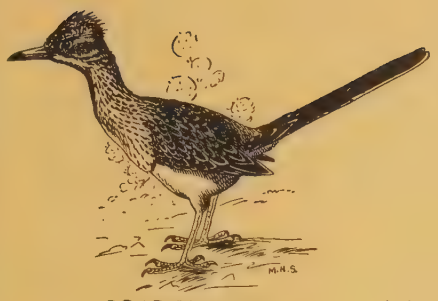
4. Five hours later

5. Fifteen minutes later

6. Forty-five minutes later

7. Ten and one-half hours later

8. One and one-half hours later



ROAD-RUNNER

Deserted Deserts?

The thirteenth in Nature Magazine's series of educational inserts

By E. LAURENCE PALMER

Animal drawings by M. Hope Sawyer: Plant drawings by Elizabeth L. Burkmyer

More than twenty times I have gone from the East Coast to the Pacific Coast, passing through desert areas by Pullman, day coach, and automobile, by night and by day, in winter and in summer. Often I could stop for a few hours, days, or weeks in a desert. I have never prospected for gold in a desert, or dragged my bones through a cactus thicket in search of water. I have never been lost in a desert sand storm, shot off a toe because of a rattlesnake bite, or gone blind from the light reflected by desert sand dunes.

CACTUS WREN

In spite of having missed such experiences, I feel that I know enough about our deserts to wish to share my convictions that deserts are worth knowing better. There is no need here to review the details of desert formation; textbooks will supply these. Neither can we give attention to all the interesting plants and animals there found in abundance. Earlier articles in Nature Magazine have dealt with some spectacular desert species. The fourth insert of this series treated the desert tortoise, the horned toad, the fence lizard, the chuckwalla, the gila monster and some close relatives of other desert reptiles. The seventh discussed such desert beasts of burden as the burro and the camel. The sixth dealt with some minerals common in desert lands.

The plants and animals selected for consideration here are those that I have seen in deserts or semi-arid regions, and which seem to be most commonly mentioned by those who know these areas best. The species selected are not always the most common (in some deserts they may be absent) but they, or the signs they leave, are generally conspicuous in one sort of desert or another.

Shortly before writing this article, I was driving through what seemed to be a deserted desert when we saw an antelope just a short distance away. Naturally, we stopped to investigate, but the story of this antelope is not half so important as some other things associated with it. The antelope moved off and we followed as well as we could. Things began to happen in what had seemed to be a deserted land. Within fifty feet of the road, we started eight jack rabbits. Lizards scuttled into the sage brush. Two magpies flew up from an inconspicuous rabbit carcass. Ants swarmed over little hills that had escaped our attention, and the sands were marked with tracks that could not possibly have been seen from the moving car. Some distance farther on, we came upon the body of a coyote at the edge of the road. As we slowed to look, a live coyote moved silently off into the brush. In one mile through that stretch of desert I counted the remains of one hundred and ninety jack rabbits that were being pressed steadily into the hot asphalt on which they had attempted to match wits and speed with an automobile. How can anyone feel that a desert is deserted? Why step on the accelerator when going through a desert and thus miss chances to observe its life?

ELF OWL

GAMBEL'S QUAIL

BURROWING OWL

Whether the desert you visit is in southern Idaho and eastern Oregon, or in the Mohave, the Sonoran, or the Colorado desert regions, it is not deserted if you give it a chance to show itself to you at different seasons, and at different hours.

You cannot judge a desert animal by its behavior in captivity. It may be difficult to activate a horned toad in a terrarium, but on the hot sands of a Utah desert it vanishes before your eyes with incredible speed. A tarantula that a college chum kept on his desk near mine would crawl leisurely around his collar and over his hands, but one of this spider's kin that I met in a southern California desert had plenty of "git up an' git" to it. There must be something to life in sand exposed to sun that makes a spider, a horned toad, or a human, behave differently than when life has been stimulated only by sunlight refracted through the glass and shades of a northern laboratory window.

While all deserts are for the most part more poorly supplied with usable water than the non-desert stretches, the reasons for this may vary and the signs of these differences

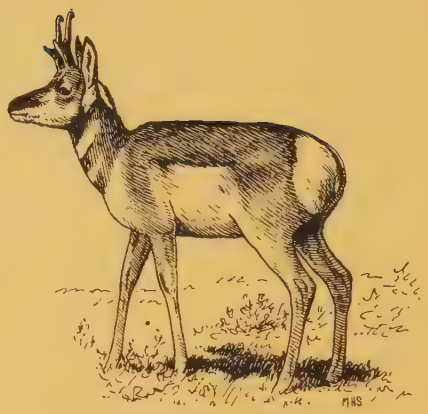
SAGEBRUSH

MISTLETOE

MESQUITE

CREOSOTE BUSH

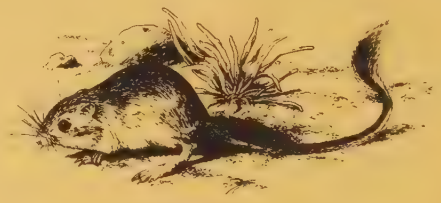
may be conspicuous. One who knows the Sonoran desert may have one picture that he thinks is representative. Others, who form their concepts of deserts from Oregon, Utah, or the Salton Sea, may have different pictures. Each may be right. With the development of great hydroelectric and irrigation projects, many desert attributes are disappearing. Some of this land will be improved by the change; much will not. What are the signs by which the casual visitor may recognize the possibilities of a particular area?



PRONGHORN ANTELOPE

Where true greasewood and shadscale grow most conspicuously we may be reasonably sure of the presence of alkali, either at the surface or at a depth of a foot. The upper foot of soil may be too dry in summer to sustain ordinary plants, and the alkali deeper down may prevent many deep-rooted species from surviving. The result is that the only plants that can continue to exist are those like the true greasewood and the shadscale. If such soils are irrigated and the alkali is washed out, they are generally able to support some kinds of crops and therefore irrigation is practicable. In the true salt flats, where the soil may be wet with salt water to the surface, it would be unwise to attempt it.

Where drainage is poor, as in some of the deserts of Utah and in the Salton Sea region, or in different areas in some sixteen of our western states, alkali is an important problem in agriculture. In some thirteen percent of the lands irrigated it is such a serious problem that crop production is impossible or unprofitable. Such areas should not have been reclaimed, but should have been left to satisfy the interests of naturalists and wildlife, if for no other reason. Nature Magazine has repeatedly advocated a sane policy in this connection.



KANGAROO RAT

Alkali soils are those that include enough concentration of any soluble salt to injure crop plants. This includes the chlorides, sulphates, carbonates and nitrates of sodium, potassium, and magnesium, and the chloride and nitrate of calcium. Even the valuable fertilizer sodium nitrate may, if sufficiently abundant, be considered as responsible for an alkali soil. The carbonates of sodium and potassium are true alkalies and, if there is sufficient organic matter in the soil, may produce a dark or even a black incrustation on the soil ordinarily considered as "black alkali". The other alkalies produce a white incrustation and are spoken of as "white alkali".

Obviously, many types of desert are possible where so many true alkalies and neutral salts are involved in their formation. With each variation, we get conditions favorable to a different group of plants. With each different set of plants, we get a different set of animals living on or associated with those plants. There really is no such thing as "*the* desert"; there are many different kinds of deserts.

The question of air in the soil is almost as important in determining the nature of a desert as the amount of water. Unless roots can get air they cannot grow. While mesquite roots can grow where the soil atmosphere has less than three percent of oxygen, cactus roots stop growing under this condition. If, then, we find cactus giving way to mesquite, we may guess that the soil may be more compacted; that it will be more difficult for burrowing animals to work, and that even though the water supply may be less near the surface where the cactuses are found, there may be more interesting animals present. This does not imply that a mesquite desert is

JOSHUA TREE

SHADSCALE

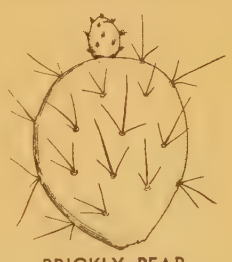
deserted by animals, but that animals will probably be different in the loose soils where cactuses flourish.

This looseness of soil creates another type of desert when the soil is sandy instead of being composed of finer softer materials. Unless it is anchored by plants, it may be constantly shifting with the winds, and form dunes. Plants, to survive, must be able to live with much of their tops buried, or with much of their roots exposed. This shift may be alternated from year to year as the crests of the dunes pass on. Such a desert, of course, calls for a different type of animal life.

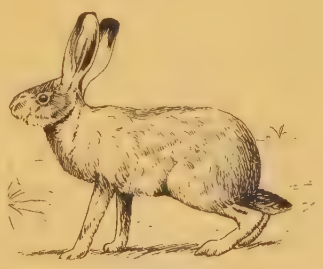
All of these changes, which provide animals with, or deprive them of, their homes, also affect their supply of food and of water. Most of those able to exist get along well without water as such. The water they need may be formed in the processes of digestion. They get along very well. In fact, they are not able to survive where there is much water, so we need not pity them because of the seemingly harsh environment in which we find them. A kangaroo rat would be nearly as unhappy swimming as a brook trout would be leaping around a cholla trunk. Neither could eat, sleep or rear young in an environment ideal for the other. We must recognize the eternal fitness of things that Nature has worked out in different places, and not try to make the world over to suit the desires of any one type.

RUSSIAN THISTLE

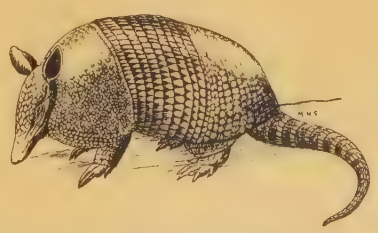
Many of the deserts of the southwest are conspicuous because of cactuses and the creosote bushes. These areas have little value for grazing either by domestic animals or by the wild ruminants, although they do support many smaller mammals, birds and reptiles. The creosote bush often grows so evenly spaced as to appear to have been set out. Because of its tremendously deep root system, it can survive in almost rainless regions for as long as three years. Because of this hardiness, it has little competition and often forms a pure stand. It is probably the most widespread and conspicuous of our southwestern desert shrubs. Its leaves are evergreen, resinous, fragrant and resistant to drying. It, too, bears the name of greasewood, but the difference between it and the true greasewood should be obvious from the sketches. As indicated in the charts, its presence marks definitely the line between two divisions of the Lower Sonoran Life zone, and can be used to trace old shorelines in the valleys where the plants live.



PRICKLY PEAR CACTUS



CALIFORNIA JACK RABBIT



NINE-BANDED ARMADILLO

When rain does come to a desert characterized by creosote bush, startling things happen. If there has been a winter rain in such an area, the bushes burst into yellow bloom in April and May. Shortly after, the fruits appear.

During this time, the desert looks most undesert-like. Not only do the perennial creosote bushes make a showing but the ground yields a host of showy annuals. At this time, the "dead" sticks of ocotillo burst at their tips in flaming red blooms, and if cactuses are present they surprise one by flowering. Yuccas like the Spanish dagger and the Joshua tree spout great flower clusters. Desert lilies, white with bluish-green bands down the middle of each petal; desert evening primroses that turn from white to pink as they age; flame-colored or yellow Mariposa lilies; delicate, greenish white, or reddish desert verbenas, and abronias; green and yellow-stemmed and purple- or white-flowered squaw cabbage, *Stanleya elata*—these are only a few of the plants that appear after a rainfall in different areas. All of these are spectacular and conspicuous for short periods, but they must be seen at their best to give the desert its due.

GREASEWOOD

We must not assume from this description of a desert in flower that such areas merit exploration only at this spectacular period. Even in the Sonoran desert, at its drier times, one finds the taller plants as interesting as those on the ground.

Any bunch of plant material high on some shrub is worth investigating. Most of them may be balls of desert mistletoe, but some of them may be nests of birds or of mammals. Similar balls, not so high, may be nests of cactus wrens, or verdins, or other birds. If large and not round, they may be nests of road-runners.

The mistletoe spheres have many interesting stories associated with them. If we think of them only as parasites, destroying, injuring, or at least robbing their hosts, which have a hard enough time of it anyway, we might condemn them. But if we recognize that their berries are wet, and form the major food and water supply of many of the birds of the region, we may feel differently. Here is a plant that, in a sense, forces other (Continued on page 92)

COMMON NAME SCIENTIFIC NAME	CALIFORNIA JACK RABBIT *Lepus californicus*	DESERT KANGAROO RAT *Dipodomys deserti*	NINE-BANDED ARMADILLO *Dasypus novemcinctus*	PRONGHORN ANTELOPE *Antilocapra americana*
DESCRIPTION	Length, about 2 feet, with 4-inch tail and 5½-inch hind foot. Weight, to nearly 6 pounds. Female, with well developed fluff of long soft hair on belly. Color, dark brown with white patches on forehead, around eyes, on back of ears; top of tail and tips of back of ears black; paler, in summer.	Length, to 13 inches, of which 7½ is tail. Forelegs, small, and hind legs, long, the hind foot measuring over 2 inches long and having but 4 toes. Ears, short and rounded. Eyes, large and beautiful. Cheek pouches, well developed. Whiskers, long and conspicuous. Color, bluish, fawn colored above and gleaming white beneath, even on tail and tail tuft.	Length, to 28 inches with tail about 1 foot. Weight, to 15 pounds. Body covered with bony plates with 7 to 9 movable joints around the middle permitting animal to curl into a ball. Color, variegated flesh, gray and black. Snout, ears and claws, long. Toes, 4 on front feet, 5 on hind.	Length, to over 4 feet, with 3½-inch tail. Standing 3 feet at shoulder and 4 feet to top of head. Weight of buck, about 100 pounds; of doe, around 90 pounds. Horns hollow on a bony core like goat's but branched and shed each year like a deer; also 4 teats and woolly under-hair like a deer. Each foot with two hoofs. Color, tan and white with bucks darker.
RELATIVES AND RANGE	Order Lagomorpha. Family Leporidæ. Black-tailed Jack, *Lepus californicus*, Nebraska and Texas to California and Washington. Common on open grasslands particularly in extensive ranges, not in woods or swamps. White-tailed Jack, *L. campanius*. Gray in summer, white in winter. Northern and western states from western Wisconsin to California.	Order Rodentia. Family Heteromyidae. Probably nearly a hundred kinds of kangaroo rats known, ranging from southern western Canada to middle Mexico. A square mile may support 1,000 animals. Common in warmer zones of western North America; this species in western Nevada, Arizona and eastern California.	Order Edentata or Xenarthra. Family Dasypodidae. Found among vegetation near rocky country where caves may be accessible. From sea-level to 10,000 feet elevation, from the lower Rio Grande River country, and south into Mexico. North to 33° latitude in Texas and adjoining parts of Louisiana. Usually confined to semiarid.	Ungulates of the Family Antilocapridae. Southern Alberta and Saskatchewan through western Dakotas, Nebraska, Kansas and Texas into northern Mexico and west through Lower California, southeastern California, Nevada, southeastern Oregon and southern Idaho. Individuals, 2 or 3 square miles.
LIFE HISTORY	Probably polygamous, breeding in warmer months. Young, born 30 days after the mating, 1 to 3, well developed. Kept by mother in individual and separated spots and nursed about 7 weeks. Possibly 2 litters in the South but only one in the North. At birth, weigh 2 or 3 ounces, are well furred and have eyes open, ears and legs at first short but begin elongating at 10 days.	Social animals, though families commonly separate in tunnel homes. Underground tunnels with some entrances closed connect food storage, dung deposit; nesting rooms, (8″ x 10″ x 5″) and extend over 3′ underground. Nest lined with fine plant and animal material where in April or later 2 to 6 young are born. Dung of adults, thick ½-inch spindles.	Sexes in general resemble each other. Young, 4 to 8, born February to April, at first with soft flexible skins much unlike the hard shells of the adults; have eyes open when born and when able leave home den and follow mother about somewhat like little pigs.	Both sexes horned, the doe's smaller. In September and October bucks form harems of does won by fighting. Kids 2 or 3, born in May or June, scentless and able to walk; can outrun dog in 10 days. Mother defends young alone. Young follow mother at 3 weeks. In July, does and young make small herds joined in August by young bucks.
FOOD AND HOME RELATIONSHIPS	Strictly plant-eaters. Adults do not dig burrow or have home other than an area. May enter burrows to escape danger. Rarely social animals in any sense. Rarely drink, water being formed from food. Speeding blacktail may jump a dozen feet and leave tail mark on snow. Speeding whitetail may leap 20 feet and leave no tail mark. Speed, 28 miles an hour. All carnivores are their enemies but man particularly.	Food, probably solely plant material from which water is extracted so animals need never drink. Food of related banner-tail gathered and stored during journeys only at night when a rat may leap 8 feet at one jump and of course easily escape most mammal and bird enemies. Animals do not hibernate or migrate. Captive animals may fight by striking with hind legs and squeaking but never vicious among themselves.	Food, almost exclusively insects, chiefly ants and beetles mixed with earth. Droppings, like small clay marbles. Has poor sense of sight, excellent ability to smell and apparently is highly sensible to jarring of the earth. Can run with surprising speed to escape its many enemies. Largely nocturnal.	Food, entirely vegetable. Herds and individuals kept together by bucks or by family instinct helped by flashing white rump which serves as danger and recognition signal. Escape from enemies or fight. Speed to 32 miles an hour; can leap 4- or 5-foot fence. In winter, migrate to suitable grazing areas usually in herds.
RELATIONS TO MAN	Provides food for carnivores and for man. Fur also has some little value. Add "atmosphere" to the great open places but also serve as serious competitors with live stock for forage. Are controlled by great drives by hunters. Have many parasites and carry tularemia, which may be fatal to man. One square mile known to have supported 8,000 jacks.	Probably of little economic importance, but of tremendous interest. Make excellent pets. Help let air into desert soil and turn soil in making burrows often building large mounds of excavated soil. Might destroy grain if they were abundant in grain-growing territory but they are not. Should be known better to be thoroughly appreciated.	In some countries, are encouraged as destroyers of ants but in other places are disliked because they disturb gardens, even though the latter activity is evidently directed not at plant destruction but at plant enemies.	Beautiful animals relatively harmless, competitors with grazing animals for forage. Flesh good. Numbers in former times estimated at 40,000,000; latest estimate about 165,000. Worthy of more protection from hunters, at present their worst enemy. Enticed to within range of guns because of inordinate curiosity.

GAMBEL'S QUAIL *Lophortyx gambeli*	BURROWING OWL *Speotyto cunicularia*	ELF OWL *Micropallas whitneyi*	ROAD-RUNNER *Geococcyx californicus*	CACTUS WREN *Heleodytes brunneicapillus*
Length, to 10 inches; tail, 4 inches; wing, 4½ inches. Male, with 1½ inch black, curved plume on top of head, chestnut crown, pale slate-blue back and breast, black cheeks and throat and belly, and brown and white flanks. Female, duller without chestnut crown and with shorter plume.	Length, to 11 inches; tail, 3½ inches; bill, ½ inch; wing, 7 inches. Head, without ear tufts. Legs, long, nearly bare, and with bristly toes. Adults, brown with white and buff spots and bars. Tail, white-barred. Young, with plain brown upper parts, plainer appearance generally and with dark rather than a white throat band.	Length, to 6 inches; tail, 2 inches; wing, 4 inches. Shorter than the pygmy owls. Head without ear-tufts. Eyebrows, cravat and underparts, white; interrupted white collar, and wings with whitish spots; otherwise largely gray or brown speckled. Young, more brownish gray on top of head.	Length, to 2 feet; tail, 1 foot; wing, 7 inches. Bill, curved downward. Feathers, coarse. Upper parts brown and white streaked. Middle tail feathers, olive with purple gloss. Throat and belly, white. Eye, yellow to orange. Legs and feet, pale blue. Sexes, colored alike. Young, like adults but less conspicuously streaked.	Length, to 8 inches; tail, 3 inches; wing, 3½ inches. Females, slightly smaller than males. Tail, rounded. Feathers of back brown with white middle streaks. Tail feathers, brown and black. Underparts, white. Young, with back spotted instead of streaked, with white and black spots on chest smaller and duller.
Order Galliformes. Family Perdicidae. In dry, hot valleys and bottom lands from southern California and Nevada to Arizona and southwestern Utah with stations in Texas and Mexico as well. Introduced and well established in southern Colorado.	Order Strigiformes. Family Strigidae. Western species breeds from southern British Columbia and Minnesota to Argentine and Chile though not continuously; migrates slightly in northern part of range in March, April and October. Florida species at home in central and southern Florida.	Order Strigiformes. Family Strigidae. Whitney's (southwestern), Texas (eastern), and Sanford's (California). Elf Owls range through southwestern United States and Mexico. Locally most abundant; not migratory. Haunts low, hot, dry, desert river bottoms and adjacent lands.	Order Cuculiformes. Family Cuculidae. California and Lower California east through Utah, Colorado, Kansas and Texas and tableland of northern Mexico in deserts and mesquite-covered arid and semiarid lands. Does not migrate.	Order Passeriformes. Family Troglodytidae. Desert regions of California, Nevada, Utah, Arizona, New Mexico and Texas and northern states of Mexico.
May be found with the scaled quail with which it may cross. Nests from June to August, the nest being a hollow, sometimes with lining, containing 10 to 12 white or buff brown, purple or pink spotted eggs; little chicks able to run about as soon as hatched. Covey stays together until grown or longer.	After interesting courtship of caresses, low song and bows, nest is built in burrow underground, of fine materials. Here are laid from April to June, 6 to 11 smooth, glossy eggs, about 1 by 1⅕ inches; both parents incubate about 3 weeks. One yearly brood. Young almost naked, plumage developing and being molted by July. Adult molt, September.	Nests in holes made to 20 feet up sahuaro cactus by Gila woodpeckers or gilded flickers in May, laying 3 to 5 pure white, glossy, granulated eggs about 1 inch long; incubated 2 weeks by both parents, hatch at intervals into helpless young soon covered by white down. Molts, June and July; annual molt, in September and October.	Usually solitary but builds nest, usually unlined, about 1 foot in diameter of sticks and twigs 3 to 15 feet up in low tree or bush where it is concealed by vegetation. 4 to 6 unspotted, white or pale yellow eggs, about 1½ by 1⅕ inches; incubation beginning after few eggs are laid, lasts 18 days. Mother tries to entice enemies by feigning injury.	Birds nest in colonies with males building dummy nests in which they may roost. Nest, 6-inch globe of dried grasses with side entrance; may be used and remodelled in different years: sometimes lined with feathers; nests also used by mice and other animals. Eggs, 3 to 7, white or buff with many red-brown spots.
Food, from January to June almost wholly vegetable matter, including mistletoe berries, mesquite leaves, cactus fruit and seeds and other seeds. Summer food, essentially insects, principally grasshoppers, the young feeding almost exclusively on insects such as ants, leaf hoppers, stink bugs and aphids.	Food, almost wholly insects and scorpions, with some few lizards and small mammals and snakes, but principally grasshoppers. May live in prairie dog holes but hardly cooperatively and while rattlesnakes also live in burrows this is distinctly to disadvantage of owls and prairie dogs. May be active in daytime.	Food, almost entirely grasshoppers and other insects, and centipedes; all caught at night when the birds come from daytime hiding place in dense thicket or hole. Calls sound like chirp or like a squeak of a rubber toy. Possibly males are gregarious during the breeding season.	When 3 weeks old, young may begin catching their own food which is highly varied, including snakes, lizards, scorpions, tarantulas, insects, birds and their eggs, rats and small mammals or about 90% animal matter, caught by pursuit or stealth. Can run 18 miles per hour for short distances to escape many enemies particularly man.	Food essentially insects. Sing through the year but more commonly in summer a song described as like grinding two small millstones together. Nests placed in cactuses are perfectly protected by them from most enemies.
Protected by coloration which almost perfectly matches environment, and by ability to escape, flying at 60 feet per second; also by large broods which get good parental care during critical periods. Enemies include hawks, snakes, coyotes, and of course man. Useful in every conceivable manner and more than make up for the little grain eaten, by the insects destroyed through most of lifetime.	Unquestionably almost wholly useful to man's interests, and should be protected. However does not favor cultivated lands and ranges and constantly being reduced. Can be recognized easily by long legs, bobbing movements and short tail.	Probably entirely useful to man and his interests; so unique that bird deserves protection at all times; may be kept as pet but at such times refuses to eat other birds. Are probably less savage than pygmy owls; are also more nocturnal than pygmies. Almost entirely dependant on giant cactus.	Although campaigns have been organized to destroy road-runners as enemies of quail, these activities are ill-advised. Probably "not one meal in 1000" is of quail eggs and many include scorpions, rattlesnakes and other undesirable animals, particularly grasshoppers, which destroy valuable crops. Deserves much more protection than it gets.	Essentially a useful species and one of the birds that gives life and music to a desert at times of the day when it might otherwise seem too quiet and deserted.

COMMON NAME SCIENTIFIC NAME	JOSHUA TREE *Yucca brevifolia*	GREASEWOOD *Sarcobatus vermiculatus*	RUSSIAN THISTLE *Salsola kali*	SHADSCALE *Atriplex confertifolia*
DESCRIPTION	Height, to 30 feet; spread, to 20 feet. Branching trees with disc-like bases from which spread small fine tough roots that penetrate soil in all directions. Leaves crowded towards ends of the stout branching stems and persisting some time after they have died.	Low-branching but conspicuous shrub with somewhat spiny branchlets and bright green, rather thick leaves whose unbroken margins make them look somewhat like branches. In general, something like the gray shad-scale, and the purple-brown inkweed to which it is closely related. Roots, 6 to 7 feet deep.	Height, to 3 feet, with many-branching stems forming a huge globe. Leaves, alternate, stiff, usually prickle-tipped, about ½ inch long, with shorter sharp-pointed bracts at bases of older leaves. Young plants appear grass-like; old ones thistle-like.	Height, to 4 feet. A woody, spiny many-branched shrub which forms a great globe-like plant with some branches well supplied with egg-shaped, entire leaves and others naked or nearly so. Roots, deep and strong.
RANGE	In desert areas where there is at least an 8- or 10-inch annual rainfall. Nevada, Utah, northern Arizona and parts of California, forming forests in some places.	Arid deserts but usually where there is ground water within reach of long roots. Widely distributed and conspicuous in deserts of Utah, Nevada and California. Particularly in clay flats and salty areas.	Dry deserts or fields or waste lands, railroad embankments and meadows. Native of Asia but widely established in North America from Manitoba to California and east through New York.	In salt deserts and on exposed limestone commonly from Idaho to eastern California and northern Arizona, except in the Colorado desert, and of course wherever soil is unsuitable.
RELATIVES AND LIFE HISTORY	Class Monocotyledoneae. Family Liliaceae. May or may not flower each year, depending largely on rainfall and temperature. Formation of flowers from terminal buds stops growth in that direction and causes branching. Wind and small animals distribute seeds.	Class Dicotyledoneae. Family Chenopodiaceae. Flowers rather inconspicuously clustered at the base of some of the leaves. Each produces a single fruit which remains enclosed in a case when shed and blown by wind.	Class Dicotyledoneae. Family Chenopodiaceae. Flowers, in leaf axils, small, greenish, whitish or red, or pink, with 5-parted calyx which encloses mature fruit leaving a papery margin which helps in wind distribution. Fruits, reddish, top-shaped.	Class Dicotyledoneae. Family Chenopodiaceae. Flowers pistillate or staminate, relatively inconspicuous in the axils of the leaves, particularly towards the ends of the branches. Fruits enclosed in rounded wedge-shaped, thick calyx bracts and blown by wind, one-seeded.
FOOD RELATIONSHIPS	Parasitized by the boring beetle, *Scyphophorus yuccae,* by the larvae of the butterfly, *Megathymus yuccae,* and by other insects. The night lizard *Xantusia vigilis* is entirely dependent on the plant for food organisms and shelter.	Typical of undrained depressions of a salt desert, where it is associated with pickleweed, *Allenrolfea,* and salt grass, *Distichlis.* Geologists consider it an indicator of nearby ground water.	Green in midsummer when other desert plants are brown, but edible for cattle when young. Flowers in July and fruits mature by September when plants are too tough to be eaten and of course are generally inferior.	Once the leaves drop during the drier parts of the season the twigs soon turn to spines, these providing protection against the destruction natural by foraging animals.
PROTECTION AND ENEMIES	Protects itself by living where many competitors cannot live, by underground roots. Helps protect other organisms; at least 25 desert birds have been known to nest in these trees. Firm roots protect from wind destruction.	Loses little water and gets an adequate supply because of extensive root system. Indicates fair water content in surface part of soil which will be well drained in summer, with salty water below the first foot.	Plants can produce 100,000 fruits, which are spread from "tumbleweeds" which are blown by wind or carried by trains or motor cars over wide areas. Plants can survive conditions fatal to most species.	Possibly has some merit as forage but is more valuable as an index to the nature of the surrounding desert. Root system 2 to 3 feet deep and abundance of easily produced fruits guarantee its survival when these factors are combined with ability to survive presence of salt.
RELATIONSHIP TO MAN'S INTERESTS	Indians used red fine roots in basketry. The plants are among the most picturesque of desert plants and are gradually disappearing with changes caused by man. They should be better protected.	Cattlemen consider greasewood a valuable fall and early spring browse, but it is known to be so poisonous to sheep that whole flocks have been killed by it. Crop production without irrigation impossible where this grows.	In depression years, plants are cut green and salted and fed cattle but normally they are destroyed where possible by plowing, cultivating or burning. The ash has been used as an impure carbonate of soda known as "barilla".	Presence indicates probable a gravelly soil at least 2 to 3 feet deep, which dries in summer and may become salt at depth of foot, though not so above. Without irrigation, such land may produce crops; with irrigation and removal of alkali, it surely can.

MESQUITE *Prosopis juliflora*	DESERT MISTLETOE *Phoradendron californicum*	PRICKLY PEAR CACTUS *Opuntia chlorotica*	CREOSOTE BUSH Covillea *Larrea divaricata*	BIG SAGEBRUSH *Artemisia tridentata*
Height, to 30 feet as shrub or tree. Stems, tough, armed with branched hooks. Leaves, alternate, compound, bright green when new. Roots tough and often penetrating to depths of 60 feet for water.	Appear as great balls of twigs or as festooned drapes, the stems being green, somewhat rubbery, opposite-branched and growing as parasites on various plants usually high above the ground.	Height, to 8 feet with a trunk crowned with flat thick discs set at different angles, light green and armed with downward pointing, sharp, brittle, yellow spines. Roots, deep and finely branching from many larger roots. Leafless.	Height, to 10 feet or stunted to 2 feet. Leaves, evergreen, fragrant, particularly when wet, conspicuously dark green with a protecting resin varnish and associated with almost black stems which are slightly swollen at the nodes.	Height, to 10 feet. Stems, shrubby, much branched, tough, with mat of silvery gray hairs. Roots deep and tough. Leaves about 1 inch long and ½ inch wide, narrow, wedge-shaped, with 3 to 5 blunt teeth at end and broadest near end. Whole plant more or less fragrant when broken.
In dry places that may support little other vegetation where there is a deep water table. Colorado to Louisiana and west through southern California and south.	On mesquite and other members of the pea family, on creosote bush, ironwood, palo verde, condalia and other plants. In deserts of California and east to Arizona.	Commonly found singly in mountainous desert areas where land is rough from deserts of California, Nevada, New Mexico and Arizona. Related species under cultivation.	On light desert soils marking line between upper and lower divisions of Lower Sonoran Life Zone. One of most widespread, conspicuous desert plants in North America.	Commonest in high northern desert and "sagebrush" areas often in pure stands. From southeastern California through Nevada, the Great Basin and the plains of Oregon, Idaho, and western Montana and Wyoming.
Class Dicotyledoneae. Family Leguminosae. Flowers, yellow, pea-like, appearing from April to June and attracting many bees which pollinate them. Fruits, many seeded, sweet-meated pods, which mature in September and October and may be wind-blown or animal-carried.	Class Dicotyledoneae. Family Loranthaceae. Staminate and pistillate flowers separate, the former smelling like apple blossoms when open and being visited by insects at evening. Berries, white spheres, present from November to April. Related closely to large-leaved mistletoe.	Class Dicotyledoneae. Family Cactaceae. Flowers, yellow, to 3 inches in diameter, pollinated by insects and producing purple-covered dry fruits, which are green within and edible and which contain many seeds. There are probably 250 or more species of this genus in America.	Class Dicotyledoneae. Family Zygophyllaceae. Flowers, large and yellow, appearing suddenly with rains in April and May, and suddenly producing furry, white fruit balls which drop in late summer when plant becomes essentially dormant.	Class Dicotyledoneae. Family Compositae. Flowers, in heads about ⅛ inch in diameter crowded in clusters at branch tips and with stamens and pistils in same heads in same flowers. Ripe heads open and break off as units to be spread by wind particularly over hard snow.
Fruits, considered excellent food by Indians, and for domestic and wild animals. Indians made a cake by mashing fruits, sprinkling with water, shaping into cakes and baking in close-woven baskets under hot sand in the sun.	Gets entire sustenance from the host plant and supplies water to many birds which carry fruits and seeds to places where they may grow on new hosts. These for the most part resist attack rather well.	Both stems and fruit have nutritive value if they can be freed from the protective spines. Roots cannot survive soil atmosphere less than 3% oxygen. Stems do the work of leaves and store food and water.	Sweet scent adds flavor to food cooked over creosote bush fire. Leaves produce medicine used in Mexico for treating wounds, burns, rheumatism, tuberculosis and stomach troubles.	Plant survives drought by resting stage during which most or all of leaves are shed, producing scraggly appearance. Presence indicates light-textured soil, low run off, with no salt in first foot of soil or deeper.
Protects itself by its excessively long roots, which can survive in a soil atmosphere of 3% oxygen, which kills cactus roots. Also by rugged above-ground parts, which survive burying in sand. Has many parasites.	Inaccessible to most animals that would destroy the plants as a whole and produces fruit in such abundance, in such an attractive manner, that widespread distribution is guaranteed.	Protection by spines. Because of stored water, roots can extend themselves through dry soil to reach new supplies of water; can do this better if the soil is moistened. Some related species yield water to mules, which kick them open.	Galls caused by the gall midge *Asphondylia* make conspicuous walnut-sized swellings. Deep roots, quick fruiting season and response to rain permit plant to grow where others cannot.	Not many animals relish bitter taste. Nesting site for many desert birds. Purple galls, which look like velvet sponges in summer, are caused by the gall midge *Diarthronomyia.*
Wood, excellent fuel. Used in land classification to indicate land which will support 5 to 15 head of cattle per section and has considerable forage value at most times of the year.	Does some harm to forage trees but the Indians used to boil the fruits and eat them, and they are now eaten by desert quail, which are in turn eaten by man.	Fruits eaten by man and stems eaten by cattle and livestock when properly treated. The prickly pears have flattened joints while the chollas have cylindrical joints.	Used by man in land classification as an index that land unless irrigated has little or no value for grazing livestock. Sharing in this use are the associated cactuses and the gray burro-bush, *Franseria dumosa.*	Foliage is eaten by sheep and goats; principal food of sage-grouse; is rich in proteins and fats. Tea made from leaves is bitter and is used in treatment of colds, sore eyes and as hair tonic. Ripening seeds ground for meal by Cahuilla Indians. Wood excellent fuel for hot quick fire.

(Continued from page 87) plants to give of their water supply that animals may live.

In the northern desert regions, where the sagebrush rules supreme, life differs from that in the strongly alkaline deserts or the sand deserts. The soils are generally well drained and loamy rather than sandy. Such deserts may provide some forage, particularly for sheep. If the areas are grazed at the wrong time of the year, or too closely, much damage may result. Here is probably one of the greatest problems in adjusting private interest and public interest.

A sagebrush desert commonly grades off into grasslands rather than into forests, although in a sense a sagebrush cover is little more than a stunted forest. This is also true to some extent of the more southern varieties of desert. Temperature conditions may define the nature of a desert almost as much as the soil and humidity. In a desert like the Mohave, the surface of the soil may reach a temperature of 175 degrees F., however, the Weather Bureau maximum for Death Valley in the California Desert is 134 degrees F.

If an animal favors the high temperatures of day, as do many of the lizards, it may be active longer than if it prefers the intermediate temperature of dusk or dawn. This time limiting of animal activities may give the idea that a desert is truly deserted. Partly because desert animals, at least in the south, can live such protected lives, they are likely to have small families, but to live long. Naturally, their young come at the season when a suitable food supply is most abundant.

While many of the desert mammals dig in to keep cool in the daytime, many of the reptiles burrow to keep warm at night. Naturally, there are clashes of interest where burrows are left open day and night. Fights for burrows frequently ensue; sometimes between animals of the same kind; sometimes between close or distant relatives. Sometimes more than one kind of animal, or more than one animal of a kind, may live in the same burrow.

Kangaroo rats apparently occupy definite areas for their burrows. These they defend vigorously. The bannertail kangaroo rat puts its seeds and vegetable stores in burrows chiefly during the summer and autumn. The smaller kangaroo rat, a close neighbor, caches no food, and so must steal from its relative during hard times. Possibly because of this the bannertail is believed to kill the smaller species whenever it is found in the bannertail's burrow. Here is desert justice.

Of course, any part of the earth that can produce plants will have animals that will eat the plants, and animal-eaters will eat the plant-eaters. The deserts are no exception. Desert foxes, owls and coyotes roam over the areas at night, living on the smaller animals that are active at that time. In the day, hawks, some snakes, and roadrunners forage. The smaller forms of animal life, like the insects, spiders, scorpions and centipedes, have their activities curtailed by each other, and, more especially at night, by the owls and bats. Quail, wrens, gnatcatchers and other desert birds feed on small things in the daytime. Not all of the creatures that feed on the smaller forms are themselves small. The armadillo, which is found in certain desert lands, subsists largely on ants. It, like the badger, digs into the burrows of its intended prey and takes what it wishes.

Small desert insects attack plants and either destroy them or cause them to form a great variety of galls. Gall wasps, gall flies and aphids are among these. Other diminutive creatures may remain dormant in the soil during long periods of drought. Fifty species of protozoans have been raised from soil that had experienced eight months of drought. Desert snails are able to close their shells and even produce secretions to prevent water-loss.

Most desert animals are so colored as to be inconspicuous. This is true of the antelope, the coyote, the ground squirrels, the lizards, and most of the birds. Obviously, this favors the continued existence of such as cannot seek a refuge under ground. Few adult butterflies or moths are to be seen during periods of drought, because of the few flowers found at that time.

So we find that our deserts are all different. Yet the counterpart of almost any desert may be found at some time of the year almost anywhere. The home plate on the backlot ball grounds has some of the qualities of a desert at some period. Its plants, such as the spotted spurge, may have a milky juice like some of its *Euphorbia* relatives of the more typical desert. Its animal associates may well be ants, and the ants may establish underground burrows to exist in comfortable temperatures.

These miniature temporary deserts may be inundated with floods of water, or exposed to intense drying conditions. The sidewalks of cities, and the miles of concrete and asphalt that connect them, may at times offer greater extremes of heat and of dryness than the most orthodox of deserts. Life is there for those who would seek it. The dandelion in the lawns and the desert evening primrose in the Mohave have much in common. Each promptly gets busy on its flowering. Each is stemless, or nearly so, and produces no useless tissues. One or the other may be seen by every reader of this magazine at some time of the year. The School Page gives further help in recognizing desert-like plants and animals in your own backyard.

Study of deserts may be extended through other sources. Popular and valuable books on deserts are available. One magazine is devoted solely to deserts.

We cannot give a complete bibliography of deserts here. For elementary school or junior high school *Desert Neighbors,* by Edith M. Patch and Carroll Lane Fenton, published by Macmillan, would be worth owning. Amateur naturalists, either in high school or at home, would welcome Gayle Pickwell's *Deserts* published by McGraw-Hill. Dr. Pickwell's book is so beautifully illustrated that it should be in every home and school library where there is any Nature interest at all. Other books deal with the birds, mammals, or wildflowers of the different states in which deserts are important. One book, *Desert Wild Flowers* by Edmund Jaeger, published by the Stanford University Press, cuts across state lines and pictures attractively the more common desert flowers. Many desert articles have appeared in Nature Magazine. Consult the index to the first ten years and subsequent volume indices.

UNDER THE X-RAY

By SISTER MARY THERESE

Motion picture photography has succeeded, by speeding up the ordinarily slow movements of a flower, in portraying, interestingly enough, the external changes accompanying its unfolding, but it remains for the penetrating eyes of X-rays to reveal what is going on within the flower at this time.

The Magnificent Lily, *Lilium speciosum rubrum*, of regal grace and esthetic appeal, was chosen to pose for a series of interesting pictures that interpret the obvious to the scientist and broaden the vision of the layman.

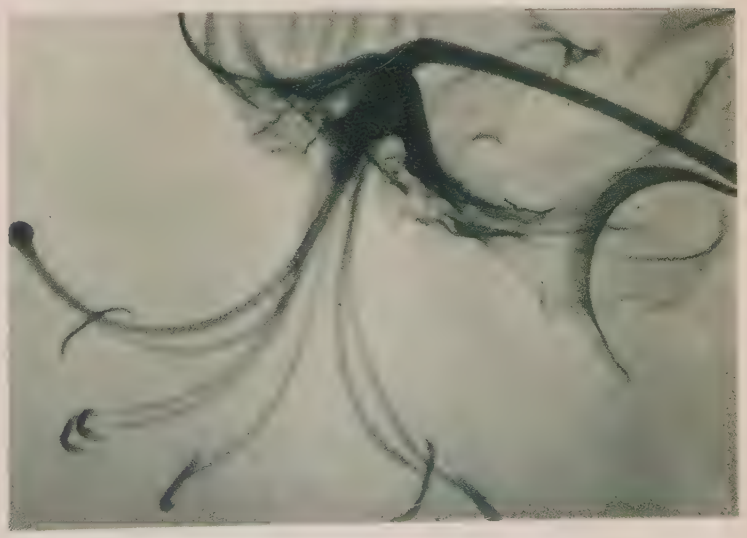
The plain-looking bud is a beehive of activity, for in a few days the pride of the family—the flower—makes her début. Although closely wrapped in the folds of the perianth the stamens and pistil are developing and approaching maturity. Within the pollen sacs of the anthers the spore-mother cells are undergoing a final division that will result in the production of pollen. In the ovary of the compound pistil the ovules are maturing. In the radiograph we can see the arrangement and size of the stamens and pistil.

For several days the elongation of the bud keeps pace with that of the stamens and pistil. Finally the bud ceases to grow in length and appears to become thicker. Not all the energy the bud receives is used in furthering its growth. Some of it is converted into heat. The warmth in the interior of the bud, by absorbing moisture from the filaments, renders them spring-like and, craving to measure their full length, they push against the enveloping floral leaves. The tip of the bud pulls apart.

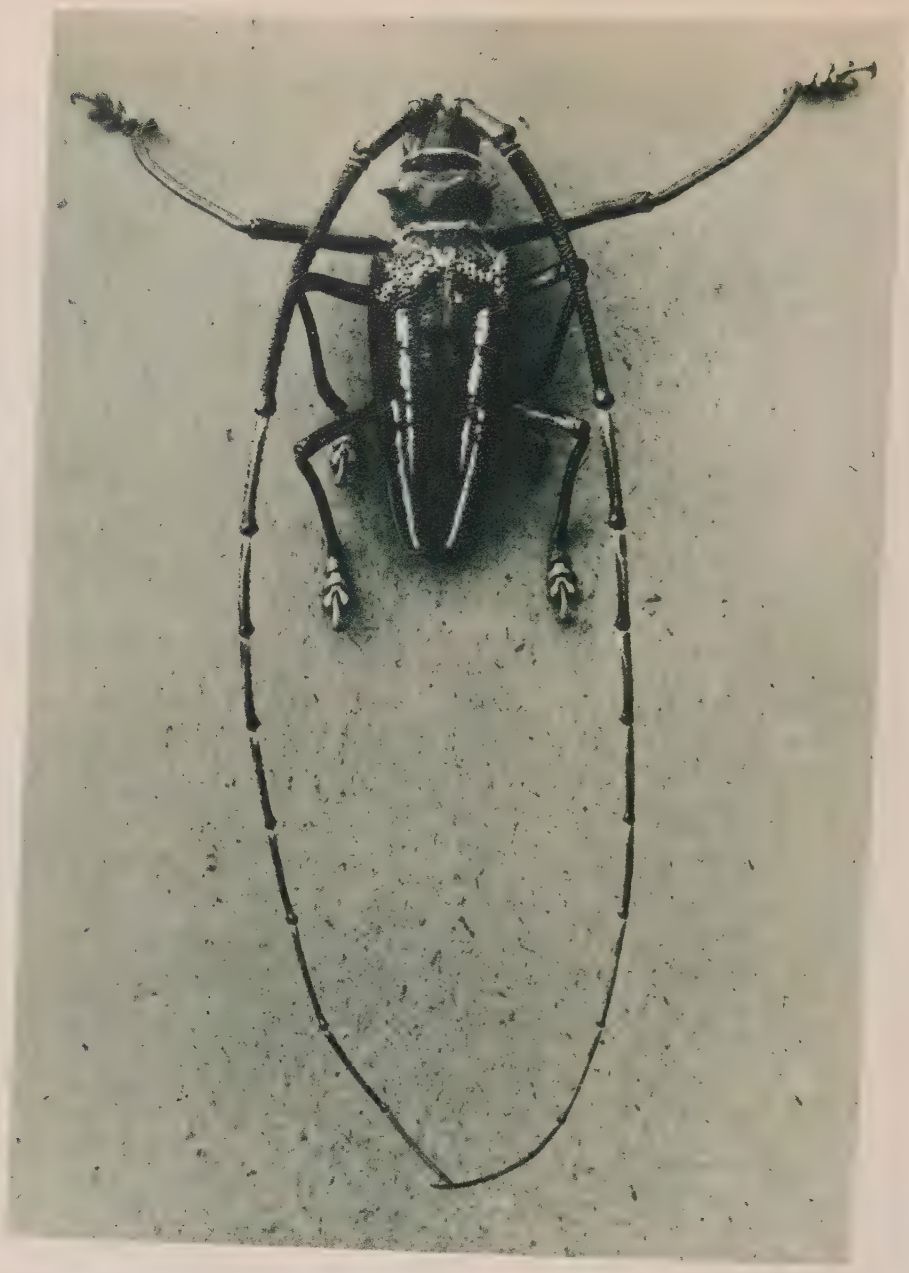
During the next twenty-four hours, segment after segment separates and curls back over the pedicel, fully disclosing the versatile anthers and the prominent pistil. For several days the beauty and fragrance of the flower will reign, and will arrest the attention of the most indifferent. But only the eye of the X-ray tube can catch and hold the ethereal and gossamer-like form of the flower forever.

9. Thirty minutes later

10. Fifteen hours, fifteen minutes later



11. Full blown



LIVING AERIALS

Some of the strange and intricate antennae of insects

Photographs from C. Anders

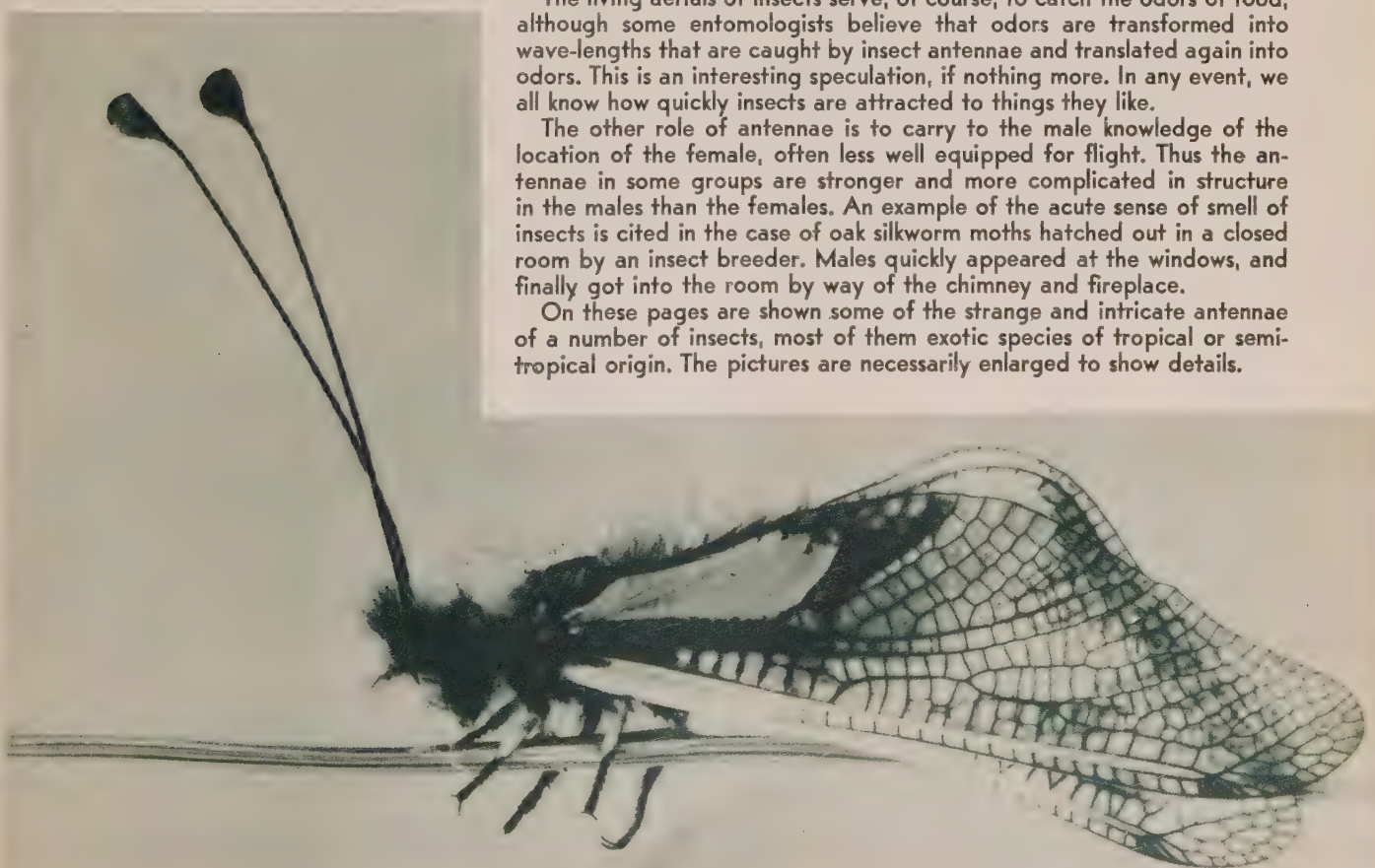
On the opposite page the antennae of a Malayan long-horned beetle and a Siamese prionid. Above, the male and female North American cecropia moth, the antennae of the male being the larger and stronger. Below, the neuropterid *Ascalaphus*, related to the antlions, with knob-shaped feeler tips.

Man's radio antennae reach out to catch the sound waves and we marvel at what he can find in the air. Even more marvelous are the antennae with which Nature has equipped certain insects. Some of these are bizarre in form, adapted to the special needs of the insect; all are designed to catch odors. These antennae, or feelers, are provided with olfactory cells in the form of small bars, cavities or balls, minute and varying in number.

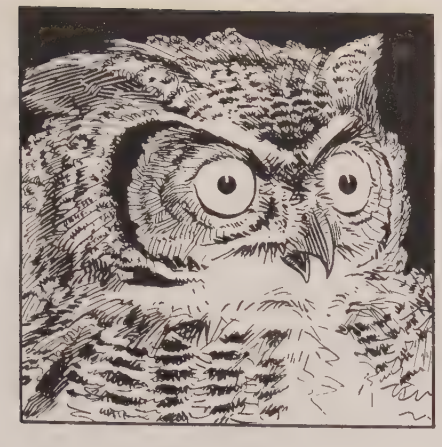
The living aerials of insects serve, of course, to catch the odors of food, although some entomologists believe that odors are transformed into wave-lengths that are caught by insect antennae and translated again into odors. This is an interesting speculation, if nothing more. In any event, we all know how quickly insects are attracted to things they like.

The other role of antennae is to carry to the male knowledge of the location of the female, often less well equipped for flight. Thus the antennae in some groups are stronger and more complicated in structure in the males than the females. An example of the acute sense of smell of insects is cited in the case of oak silkworm moths hatched out in a closed room by an insect breeder. Males quickly appeared at the windows, and finally got into the room by way of the chimney and fireplace.

On these pages are shown some of the strange and intricate antennae of a number of insects, most of them exotic species of tropical or semi-tropical origin. The pictures are necessarily enlarged to show details.



The South American long-horned beetle, *Lophonocerus barbicornis*, has the basal joints of the antennae densely haired. Those in the center well illustrate variations in antennae. First are the fan-shaped feelers of *Polyphylla fullo*, related to the cockchafer. Then comes a remarkable beetle, *Paussus*, from Abyssinia with platter-shaped feelers. These small beetles are guests of certain ants, and secrete a liquid that is eagerly licked up by the ant hosts. Finally, the mandarin wasp presenting still another variation. At the right is a Malayan longicorn beetle, *Cyriopalus*, with antennae well equipped for receiving messages.

As We  See It

IMPORTANT SUGGESTION

Speaking recently in Baltimore, Frederic C. Walcott, former United States Senator and president of the American Wildlife Institute, made an important suggestion worthy of the support of all conservationists. After reviewing what happened to many of our natural resources during what is now known as World War I, he urged the creation of a "National Advisory Board for Conservation to advise how our natural resources can be used for defense needs without imperilling the future supply."

The importance of this suggestion lies in the fact that during times of stress and emergency things may be done by those in authority—and with the best of intentions—that ignore many of the safeguarding factors involved. More often than not this arises from the fact that the whole picture is not known to those concerned; or that there has not been sufficient study of alternatives.

If, for example, a national defense official learns of, and covets, an area within a National Park supporting a forest of a certain species of tree, he might, under the plea of emergency, break through the protective barriers we have thrown around these areas, doing so at the expense of the future. Furthermore, it is hardly conceivable that an adequate supply of this particular kind of timber would not be available elsewhere on National Forest or private land. Many other ill-advised cases are equally possible.

Since World War I we have learned a great deal about conservation of natural resources. We have gotten away from the feeling that they are inexhaustible, and have learned many other lessons the hard way. We still have much to learn, but with the knowledge we have we certainly can practice conservation under emergency conditions.

It is too much to expect that a business man or manufacturer, called into the service of his country because of his particular training and background, can also be well-informed on the complex subject of natural resources, particularly on policies that have been developed relating to their conservation. He naturally will see only the immediate need and ignore other considerations and values to meet it. He needs, and should welcome, advice. After all he is, by virtue of his acceptance of emergency responsibilities, concerned about the future of his country.

The creation of such an advisory board on conservation matters would be the answer to such problems. In endorsing this excellent proposal, however, we feel that we must express our conviction that such an advisory board should not be made up exclusively of representatives of existing government agencies. These should be represented, of course, but there are important and informed national organizations that should also participate, whether they represent an industry immediately concerned with the use of natural resources, or organizations merely patriotically interested in the fundamental issues of conservation.

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CONSERVATION COMMISSIONS ★

Opposed to wildlife conservation is its exploitation. This results from insistence on present individual privileges, and profits without regard to the rights of others, either now or in the future. The root of the trouble in this field, as in so many others, is human nature, or, more plainly speaking, pure selfishness. The only antidote to the evils of self-seeking that the race has found, and this but a partial one, is management by bodies of men.

Subject to legislation and legislative bodies, control of conservation, either local, state, or national, should, therefore, be vested in commissions, whose personnel should be so selected as to eliminate as far as practicable individual and group selfishness. Authentic civil service procedure is a great step toward this end, and the special requirement should be made that the members of commissions have no financial interests in any way related to the species to be conserved. Salaries should be adequate and tenure of office should run during good behavior.

The personnel of the governing bodies should be experts in wildlife conservation—a matter with which politics in the ordinary sense should have nothing to do. They should be men of the best attainments, who really know wildlife—the animals and their interrelationships, and the possibilities of improving environment. Eventually the ideal personnel should comprise only persons with adequate professional training in wildlife management who will honor the rights of both wildlife and the public.

Roadside Conference

A REPORT

By RICHARD W. WESTWOOD

BRINGING together highway officials, planning authorities, landscape architects, garden club and women's club leaders, and others interested in highway and roadside problems, the Second Joint Conference on Roadside Improvement was held in New York December 9 and 10, 1940. The meeting was sponsored jointly by the National Roadside Council, the Conservation Committee of the Garden Club of America, the American Planning and Civic Association and the American Nature Association.

Sessions of the conference were devoted to discussion of the highway question from the viewpoints of the Public Roads Administration, the National Parks, the National Forests, states and counties; to the activities of organizations working to improve conditions; to the important subject of roadside control legislation; to reports of progress in the various states. A report of the meeting will be made available by the American Planning and Civic Association.

One of the most significant matters brought before the conference was contained in a report by Hugh R. Pomeroy, nationally-known planning authority, director of the Virginia State Planning Board, and consultant of the Committee on Roadside Development and Control of the American Automobile Association. Mr. Pomeroy's recommendations in his latter capacity have been adopted in full by the A.A.A., and represent the type of highway zoning bill now endorsed by that organization.

Roadside zoning, Mr. Pomeroy pointed out, should confine roadside commercial uses to designated commercial districts, leaving the remainder of the highway frontage for uses that are characteristic of the general area through which the highway passes, such as agriculture, forestry and the like; should require that roadside buildings be set back from the highway right-of-way lines; and should establish control over the appearance of roadside commercial buildings, and limit their display of signs.

Of outstanding importance was Mr. Pomeroy's recommendation, adopted by the A.A.A., that there must be distinction between types of roadside business districts. One is a "roadside service" type; the other "general commercial". In the former are uses that service highway traffic, such as gasoline stations, eating places and overnight stopping places. The latter type serves both the highway traffic and adjacent community needs.

"The 'roadside service' type of district," Mr. Pomeroy emphasized, "located along the open highway apart from communities or commercial centers, should properly be limited to the uses which directly serve the traffic, and uses which are of the same general type as these, in terms of their relationship to the traffic and to roadside appearance. There is no place in this type of business district for the automobile wrecking yard, which is essentially an industrial use, nor for the billboard, which is not a service type of use, but an intrusive one."

The planner pointed out that the "general commercial" type of district is properly open to all kinds of business, including outdoor advertising. These distinctions, of course, would apply to rural areas. The importance of this proposal lies in the fact that it establishes the billboard as "intrusive" and not of service to the highway user. The billboard interests have long fought against any distinction between the billboard and other forms of commerce contiguous to the highway.

Another interesting report to the conference came from Mrs. Cyril Fox, president of the Pennsylvania Roadside Council, which has been conducting an effective campaign of public education for roadside control. Mrs. Fox urged the group to remember the three words—"Tell the Advertiser", pointing out the effectiveness of her organization's protest campaign that has selected for protest a "Blot-of-the-Month" along Pennsylvania's highways. She said that the billboard interests have now substituted, in place of direct threats against her members and their husbands, the old device of "cooperation". Pennsylvania women, however, are not "appeasers", Mrs. Fox asserted, and, in an attempt to clean up the Lincoln and William Penn highways, are cooperating with the billboard interests only with the understanding that their hands are not tied, or their program compromised.

Mrs. W. L. Lawton, chairman of the National Roadside Council, described the field research work largely made possible by the American Nature Association. She said that these careful factual surveys of highway conditions have permitted graphic presentation of the situation, and have provided a means of checking on the actual effects of existing state billboard legislation. She emphasized the importance of the distinctions made by Mr. Pomeroy.

Alfred Bettman, Cincinnati planning authority, urged highway zoning as the only real solution of the roadside control problem; the planning approach instead of the nuisance approach. Mr. Bettman, who has drafted control legislation, has always stood for confinement of billboards to the commercial type district described by Mr. Pomeroy.

While the conference supplied a vast amount of information and inspiration, those in attendance seemed in agreement that the two most important developments were the clarification of rural highway zoning principles, and the dangers involved in the resurrection by the billboard interests of the old device of "cooperation". This method has been used before as a means of side-tracking legislation and checking the progress of effective campaigns against rural billboards. It has never been successful as a remedy for any large area or for any length of time. This is because it is born of subterfuge and not sincerity on the part of the billboard interests who reluctantly use it.

A MODERN DIESEL-POWERED TRAWLER ON GEORGES BANK

With each year more, bigger and more modern trawlers have been added to the fleet that harvests the cod and haddock crop by effective but definitely destructive fishing methods

ON THE BANKS

Fish facts and observations from a trawler on Georges Bank

By ARTHUR H. FISHER

Photographs by the Author

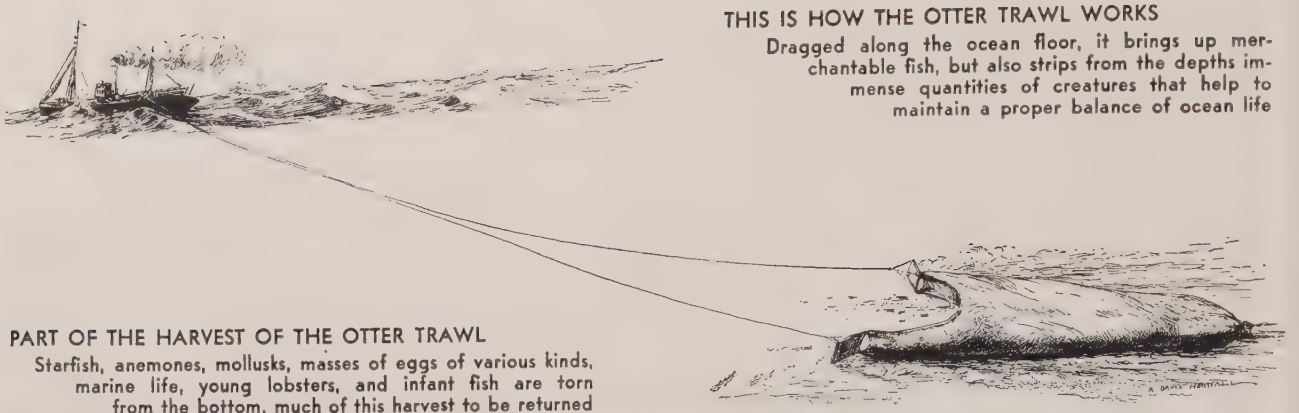
IRREPARABLE wastes of natural resources left in the wake of early empire builders, who pushed our frontiers to the shores of the Pacific, provide a story that is now a part of our national heritage. Today, in contrast, conservation has become a patriotic slogan, yet it may be well to turn our eyes eastward to the sea, where no dams can be built to upset the life of fishes, or to thwart the will of Nature, but where priceless gifts are ours.

Stretching eastward from Cape Cod, Georges Bank includes a section of ocean floor equal to the combined areas of Connecticut, New Hampshire and Massachusetts. Since Colonial days these banks have been noted as the greatest feeding grounds for cod and haddock. For generations men of Cape Cod "went down to the sea in ships" and reaped a continual harvest from these fishing grounds.

In the early days the take was comparatively small. Cod and haddock, as well as other species, were caught from the decks with hand lines. Later hand line fishing was done over a wider area from dories from the mother ship. Next came line trawling, five hundred and fifty hooks to a trawl, set and hauled by dories. In 1905, however, an entirely new gear, the "otter" trawl, was introduced into New England from the European fisheries in the North Sea. Essentially, this gear is a great flattened cone of netting dragged over the bottom by the trawling vessel. The outer edges of the net are held open by otter boards, door-like gadgets attached to towing warps like kites that plane outward. These huge nets, eighty to one hundred and twenty feet wide at the mouth, are dragged over the bottom at a speed of two and one-half to four knots, sweeping up practically every living creature in their path as they pass.

While the catch on Georges Bank was small in early days it kept pace with increasing population until, in 1924, New England fishing boats caught nearly 200,000,000 pounds of marketable fish. No thought was given to the limit of supply; demand and price were the only consideration. It was about the same year that the business of packaging haddock fillets came into being. Prior to that time haddock had always abounded on Georges Bank, but the fishermen were primarily after cod and considered haddock somewhat as a nuisance. However, haddock fillets immediately created a remarkable expanding market. During the five years from 1924 to 1929, the annual New England catch of haddock leaped from some 93,000,000 pounds to more than 250,000,000 pounds. A lot of fish—an average of 450 pounds of fish a minute landing on the piers of Boston, Gloucester and Portland eight hours a day for 365 days each year.

Still no attention was given to the limit of supply on Georges Bank. Also, during this period, the number of otter trawlers rapidly increased. By 1915 there were 11 such vessels fishing out of Boston, and in that year they landed 17,000,000 pounds of haddock. By 1921, twenty-six large trawlers landed 27,000,000 pounds, practically all taken on Georges Bank. By 1929 the fleet of large steam and Diesel-powered trawlers had increased to sixty-two in addition to one hundred and seventy small otter



THIS IS HOW THE OTTER TRAWL WORKS

Dragged along the ocean floor, it brings up merchantable fish, but also strips from the depths immense quantities of creatures that help to maintain a proper balance of ocean life

PART OF THE HARVEST OF THE OTTER TRAWL

Starfish, anemones, mollusks, masses of eggs of various kinds, marine life, young lobsters, and infant fish are torn from the bottom, much of this harvest to be returned to the sea dead. A typical catch is shown here

trawlers, taking more than eighty percent of the total catch. But, now a change had taken place, and 1929 was the peak of the haddock industry, and the depression that came upon us that same year can hardly account for the low point it has now reached—about 79,000,000 pounds from Georges Bank in 1938.

One has only to take a single trip to Georges Bank on a large modern otter trawler, and to witness the fleet in operation, to appreciate what is a large factor in bringing about this decline. Corollary fluctuations in production of young also contribute to the depletion. What I saw was a mechanized odyssey of the sea, accompanied with waste—never-ceasing waste!

From the time we reached the banks, and the first trawl was "shot", until we headed back to Boston, I saw ninety tons of cod and haddock go into the hold. How many tons of destroyed edible fish I saw go back into the sea to feed the ever-attending gulls I cannot say; fish that would be most acceptable in Europe, particularly today, but are not acceptable in our exacting markets. About every hour and one-half the winches turned, the huge "cod end" of the trawl "bobbed", came dripping over the side, and dropped from hundreds to thousands of pounds of fish into the "checkers". With them came a wide variety of forms of sea bottom life. Once more I saw the balance of Nature taking the ruthless beatings that only mankind can administer. It was not difficult to picture that huge trawl, with its great wooden rollers pounding over the ocean's floor—a juggernaut turned loose in a submarine garden that it had taken ages to create; the feeding grounds and kindergarten of countless bottom-loving creatures. It was amazing to see the number of living things that came aboard with each haul. All, except the marketable-size fish sought, were regarded as trash and returned, mostly dead, to the sea. Gaily-colored starfish and their relatives, anemones, many kinds and sizes of mollusks, young lobsters, masses of the eggs of varied marine life, to say nothing of the thousands of infant cod and haddock that were unable to escape. Marine ecology apparently plays no part in the minds of either trawler captains or owners; marketable fish is their quest.

Investigations and natural history can well be left to the scientists. It is, of course, impossible that they are blind to the fact that a real drama is being enacted; that the future of the New England fisheries, now hanging in the balance, is menaced by great danger. We know from past and fairly recent experience what has happened to the wildlife across our land areas. To some extent we can repair this damage by restocking and protection. Unfortunately we also know that restocking of marine life is, in the main, neither practical nor possible.

The blame for the rapid decline of the fish population on Georges Bank rests largely with the fisheries. The heavy take of the trawler fleet was bound to cause this decline unless the haddock population was absolutely unlimited in numbers. Investigations and developments have proved that this is not the case. The fish on these banks

are definitely limited in numbers and always have been. Many thought that the bison on our western plains were unlimited; that no killing by man could possibly decimate these great herds. Then the slaughter began, and in ten years they were reduced to the border line of extinction.

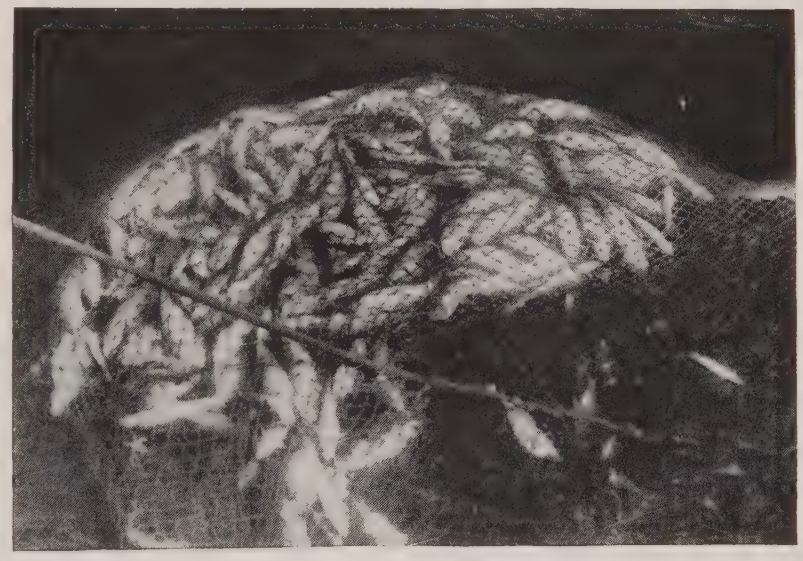
History has been repeating itself on Georges Bank during the past decade, since the year these banks furnished the peak of their catch. The catch of marketable haddock from 1925 to 1931 reached a combined total of one billion pounds from Georges Bank alone. This equals approximately 100,000 pounds for each square mile of the fishing grounds. Furthermore, records show that during nine months of 1931, two-thirds of all the haddock taken on Georges Bank were under marketable size. During the same year trawlers destroyed 63,000,000 baby haddock, equaling in number a commercial catch of 200,000,000 pounds, and every brood of young fish may be subject to this extensive destructive method before it reaches marketable size. In other words, for the past ten years the number of haddock killed by commercial fishing has been greater than the number produced.

It takes no skilled investigator or scientific Moses to prophesy the future of Georges Bank as a national asset. The handwriting is plainly on its waves, and unless remedial measures are taken, its knell will ring out louder than the buoys that guide the trawlers out of Boston.

Consider the pre-war North Sea, where a destructive and intensive fishery has been in operation over a much longer period of time. During the years 1929-32, British first-class trawlers (averaging 241 gross tons) fishing the North Sea averaged only 550 pounds of haddock and 1830 pounds of all marketable fish per fifteen hours of actual towing time. During the same period New England trawlers of equal tonnage, fishing Georges Bank, averaged 10,400 pounds of haddock and 14,500 pounds of marketable fish for the same fishing time. These were considered lean years on Georges. The North Sea marketable catch included haddock down to one-

THE "WHEELS" OF THE OTTER TRAWL

These pound their destructive way over the sea bottom, easing the way for the trawl as it gathers up its varied ocean harvest



THE COD END DUMPS ITS MASS OF FISH

Below, the string of the cod end is pulled and its contents emptied aboard the trawler. The waste goes back to the sea

half pound, dogfish, goosefish, skates and rays, all of which go back into the sea in America as waste. Such takes as are the rule in the North Sea could not support our New England fisheries at anything approaching a major industry.

The natural reaction to this situation is the shifting of the fishing fleet to new grounds. This has already begun with the shift of our large trawlers to the Nova Scotian banks, but as these banks are already showing signs of depletion, again the situation becomes serious. Furthermore, as we go farther away from our home ports, production costs rise rapidly, intensified by greater difficulties in preserving the catch.

Since it is impractical, and, it seems, impossible, to assist materially in producing young fish, certainly we should lose no time in conserving those now produced on the banks by natural spawning. It is now up to the fishing fleet to aid in every way if they wish to continue as a large and all-important industry. The preservation of young fish is certainly the answer. Larger mesh in the trawls, which allows the escape of many under-sized fish has been adopted, but has not yet been put into effective general use. When put into practice, this will undoubtedly be a material help. Closed seasons and closed areas would entail hardships that do not appear necessary unless no better methods can be found. One aid to the solution of this problem lies, of course, in scientifically directed management of the fishery. This would take into account such factors as an apparent optimum level of abundance. It has been found that when there are too many or too few adult haddock the new supply is inadequate, due, on the one hand, to competition or cannibalism, and, on the other, to insufficient spawning population.

At this writing, there is no law to control this industry or the methods used by those who conduct it. In 1933 the British Government enacted three measures for the preservation of its fishing industry. The first established minimum sizes of fish allowed to be sold; the second established closed fishing areas; the third calls for minimum sizes of mesh for nets. With these facts before us, are we going to wait until the fish population on our banks is reduced as it has been in the North Sea; to wait until our whole fishing fleet must fish fifteen to twenty days to catch as many haddock as they now average in one day on Georges Banks, even in its present depleted state?

And so, as we returned homeward with 180,000 pounds of marketable fish below hatches, and I saw the harbor lights of Boston gleaming dimly through the fog, I thought of all those living creatures that had gone back dead into the sea; back on Georges Bank which played an important part in our American Revolution. We fought for Georges Bank more than 150 years ago. It is truly a national heritage and another battle must be fought to preserve it; a battle of common sense versus quick dollars. Let us hope that common sense will prevail, and that the New England fisheries will "live long and prosper".

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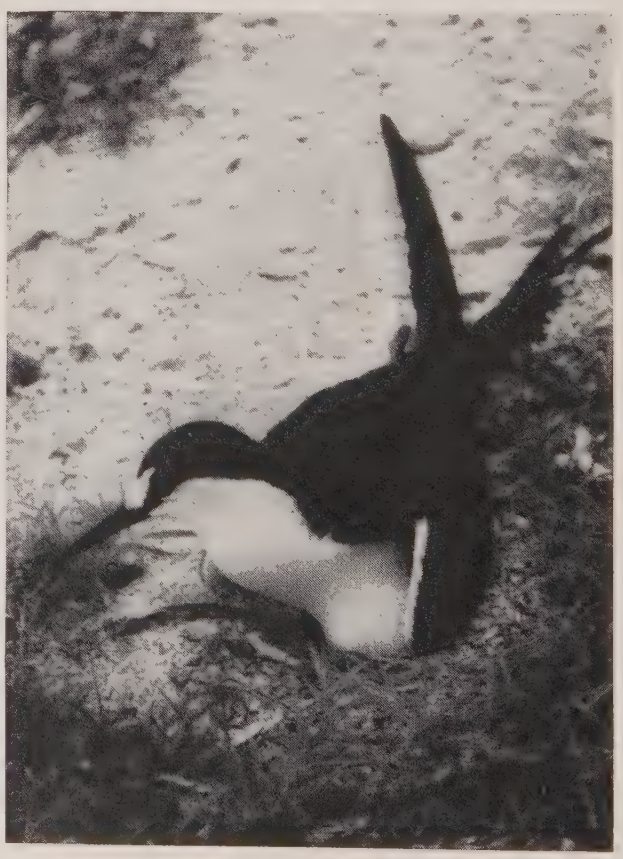
Tern On The Nest

By HUGO H. SCHRODER

HAVE YOU ever seen just how a bird covers her eggs? It is seldom possible to observe this feature of incubation, either with a wild bird or a domestic fowl, because there is usually a part of the nest interfering with our vision. Of course, we can see how the bird settles down on the eggs, but what really takes place after that is guesswork on our part.

After more than twenty-five years of study and photography of wild bird life, I was finally able to witness and photograph what actually happens during incubation. It remained for a sooty tern on the Dry Tortugas Islands, Florida, to give me a demonstration of how to keep eggs at the proper temperature so that they are likely to hatch. In fact, several terns in this huge colony, where tens of thousands were crowded in an area smaller in size than the average city block, were in proper position to allow the picturing of this seldom-seen phase of incubation.

You can see that this bird obligingly held her left wing far to the side, so that I could get a photograph showing how the breast feathers are parted and completely encircle the lone egg. This enables the egg to come in contact with the bird's body. Many wild birds are very shy, but sooty terns are quite unafraid of human visitors; this considerably simplified the securing of close-up photographs.



Conservation Comment

February 17 to 19 are the days that will bring together conservationists from far and wide when the Sixth North American Wildlife Conference is held in Memphis, Tennessee. Sponsored and managed by the American Wildlife Institute, the meeting will attract specialists in wildlife work and others interested from educational, administrative and other viewpoints. Sessions will be devoted to discussion of technical subjects related to wildlife management, and general sessions to subjects of wider interest and application. Related meetings will be held at the same time, including those of that rapidly growing organization, the Outdoor Writers Association.

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If all of the states followed the lead of Pennsylvania we would have a far better idea of those wildlife resources classed as game, and the effect of hunting on the supply, and other matters connected with hunting. Through a system of reports by licensed hunters many valuable facts are obtained. Figures for 1939, for example, show a kill of 5,990,219 individual birds or mammals, a decrease of about 750,000 individuals as compared with 1938 figures. Rabbits and squirrels accounted for the largest hunter's harvest, with ringneck pheasants and ruffed grouse next. Pennsylvania also keeps a careful record of the number and circumstances of fatal and non-fatal hunting accidents. In 1939 there were 44 fatal accidents, sixteen of which were self-inflicted, and 346 non-fatal accidents, 66 of which were self-inflicted. The largest percentage of accidents occurred during clear weather in the daytime, and 79 per cent of the cases were while hunting small game. The 1939 accidents represented a decline from the all-time high of 488 mishaps in 1938. Since 1929, 470 people have been killed and 2843 injured in hunting accidents in Pennsylvania.

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Virginia Wildlife, previously published in collaboration by the Virginia Wildlife Federation, and the Virginia Commission of Game and Inland Fisheries, now appears as a quarterly under the auspices of the latter. It is changed in size and format, but will continue "to bring to interested Virginia citizens factual information concerning wildlife resources and their management." Cecil F. DeLaBarre, now director of education for the Commission, will continue as editor.

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"It is about time for Florida to wake up to the fact that the army of billboards along our highways is a menace to our lucrative tourist business," declares the *Fort Myers News-Press*. "Visitors come here for the climate and scenery, and when the roads are littered with invitations to Jake's Juke and the superior quality of purgative pills, touring loses its attractiveness." The editor, who acclaimed Nature Magazine's report of Florida roadside conditions, urges a campaign of tree and flower planting along the highways, declaring the removal of the signs will not only be a boon to citizens and tourists, but to the advertisers themselves, who feel that they must make large expenditures to put up more and more signs to the point of absurdity to meet competition.

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According to the report of the Alaska Game Commission, the big-game population of the Territory numbers more than a million individuals. The report also lists Alaska as an important source of fur, with 554,725 fur pelts shipped out during the 1939-40 fiscal year. Properly managed and protected from exploitation, the wildlife resources of Alaska can be an important national reserve.

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Woodland Management is the title of a valuable pamphlet published as Bulletin No. 213 of the Agricultural Extension Service of Ohio State University. Written by J. Alfred Hall, it presents practical advice on the care and improvement of woodland areas. The subject concerns itself exclusively with the timber aspect, leaving wildlife considerations to the wildlife managers.

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In *Conservation of American Resources* Charles N. Elliott of the Georgia Conservation Commission, with the editorial collaboration of Paul W. Chapman, have produced a volume designed for use as a textbook on this subject. Dividing the book into twelve units—Steps toward Conservation, Game Birds, Game Animals, Fish, Forests, Nature's Masterpieces, Land, Water, Minerals, Animals and Plant Life, Landscape, and Planned Conservation, they have packed into 672 pages a wealth of source material and graphic pictures. Author and collaborator have chosen a rather unique method of approaching the subject, inviting a wide variety of conservation agencies, both official and private, to contribute condensed articles of self-appraisal. Naturally this method results in the presentation of favorable analyses of the endeavors of each, and as a source of information the result is interesting. Just how useful it will be to students and teachers, who may be confused by conflicting attitudes and not able to evaluate the information, is a matter open to debate.

The authors resort to the old references to the extinction of various species of birds, but, unfortunately, pay little or no attention to such species as snipe, woodcock, mourning dove, ruffed grouse, prairie chicken, sharp-tailed grouse and sage grouse—all in danger of following the route of the extinct species. We were glad to see proper tribute paid to the late William Temple Hornaday and his long leadership in conservation of wildlife. We

could wish, however, that a few more details of his contribution had been given, as well as more references to his written works.

Each unit of the book is supplemented by review questions and suggestions for activities. Unit bibliographies are supplied for added reading, and good listings of sources of information are included. We were interested to note that, in the unit on Landscape, the contention of the American Nature Association that conservation of roadsides is a part of conservation is recognized and treated effectively. This we have not seen in any other conservation textbook.

We do not feel competent to evaluate this book from the pedagogical point of view. That is for the school authorities to judge. The publishers are Turner E. Smith and Company of Atlanta, Georgia, and the price is $1.80.

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Other recent publications of interest to conservationists are:

National-Forest Vacations, a fifty-four-page, illustrated pamphlet describing the recreational facilities of the National Forests and including a tabulation of the forests, location of headquarters, special features, outdoor sports and accommodations. Copies are available from the United States Forest Service, Department of Agriculture, Washington, D. C.

The Teacher Looks at Conservation, a sixty-four-page, large-size booklet by O. E. Fink issued by the Ohio Division of Conservation and Natural Resources in cooperation with the State Department of Education. This is a discussion of many factors in conservation teaching and includes excellent references to source material. Copies available from the Division of Conservation and Natural Resources, Columbus, Ohio.

Forestry on Private Timberlands, a pictorial record of what some private timberland owners in the United States are doing to keep their forest lands productive. Copies available at ten cents each from the Superintendent of Documents, Washington, D. C. Ask for Miscellaneous Publication No. 381, U. S. D. A.

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Violation of the ban on baiting an area to lure migratory waterfowl was expensive to six Michigan men who paid a total of $3250 in fines after being caught by Federal and State game agents. The sextet comprised four hunters, all respected businessmen in their communities, although their concern for the law proved distinctly not to their credit. The other two were caretakers on the private estate where the violations, which included exceeding the bag limit, took place.

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Since the State of Florida requires automobile license plates only on the rear of the car, the Forest and Park Service has put the front of automobiles to work through the distribution of more than five thousand plates carrying a fire prevention message. Manufactured by the same agency making the license plates, these are of similar size and color and legible at considerable distances and high speeds. Florida's fire season is in the winter.

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We have been asked whether Pennsylvania's new $70,000,000 super-highway between Harrisburg and Pittsburgh will be "adorned" with billboards. The answer appears to lie in the comment of Walter A. Jones, chairman of the Turnpike Commission, who points out that the highway is built over a right-of-way that has a minimum width of 200 feet. He adds that "if anyone plans to build billboards beyond this range we'll plant tall trees and shrubs to cover the signs."

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Nearly three-quarters of a million acres of scenic, recreational and historical land were added to the system administered by the National Parks Service during the year ending June 30, 1940. The major acquisitions were, of course, Kings Canyon National Park of 454,000 acres, and Isle Royale National Park. Nearly 200,000 acres were added to Olympic National Park.

• • •

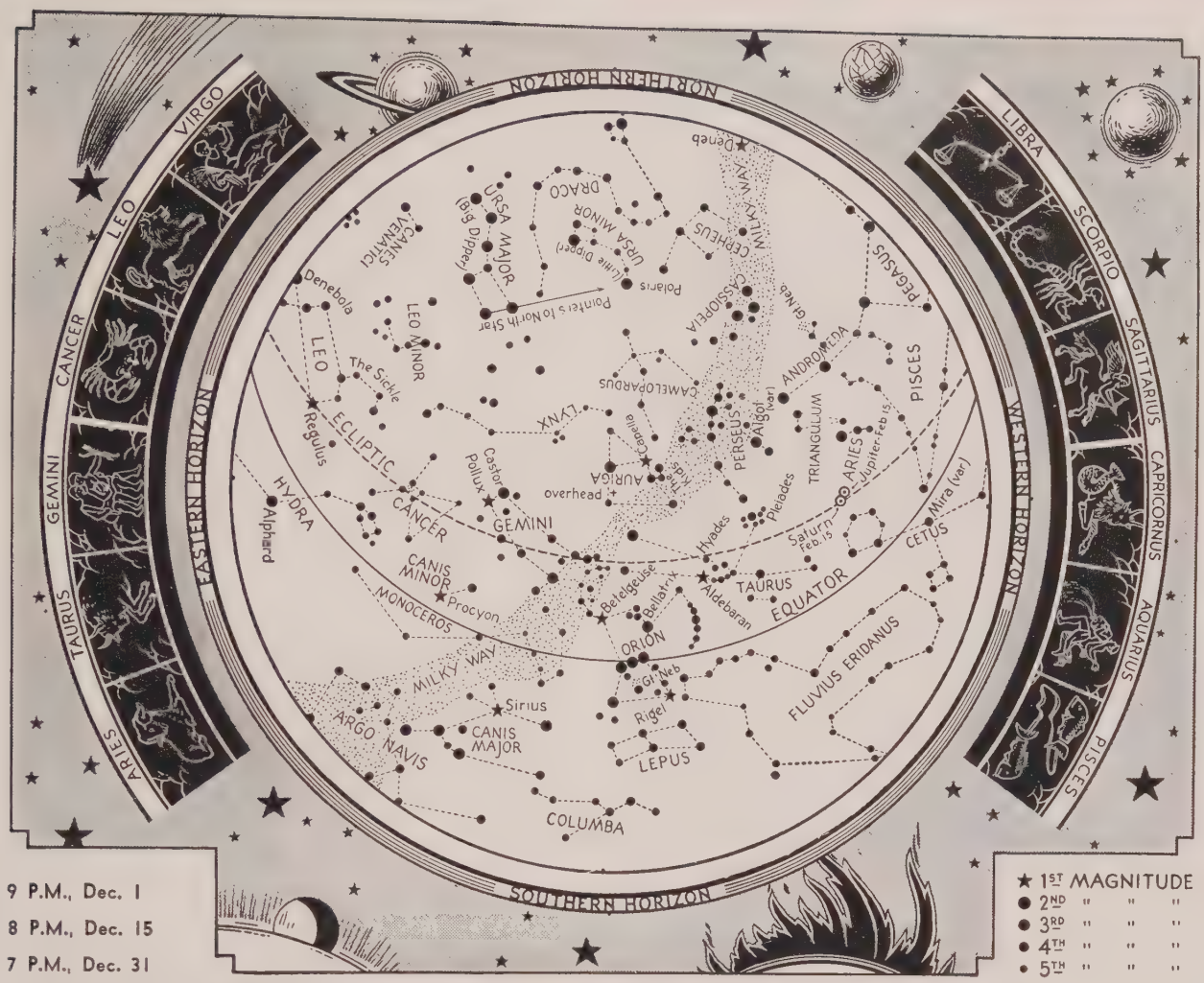
From June 23 to August 9 the seventeenth annual session of the Yosemite School of Field Natural History will be held in Yosemite National Park, California. This is a government training school for those seeking employment in the naturalist field of the National Park Service. Enrollment is limited, and this year sixteen men and four women who have college degrees in some branch of the natural sciences will be selected for the school. Those interested should write to the Superintendent, Yosemite National Park, California, for application blank and full details of the requirements.

• • •

"Conservation of wildlife is one way of making a country worth living in—a first essential in inspiring zealous defense," declares Ira N. Gabrielson in his annual report as Chief of the United States Bureau of Biological Survey. This is the last report of the Bureau under its original name, now changed to the Fish and Wildlife Service following reorganization and consolidation.

"The benefits of wildlife conservation," Dr. Gabrielson points out, "are long-time benefits. They will be as important in future requirements for good living and in future national emergencies as they are at present. If a high type of conservation is not maintained consistently, the Nation may suffer losses that will be difficult to make up."

Dr. Gabrielson's report is one of progress, but he sounds the warning that "wildlife conditions in the United States are not yet what they should be everywhere."



To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. It will not be necessary to turn the map if the direction faced is south.

What Our Observatories Are Doing

By ISABEL M. LEWIS

OF THE two hundred and twenty-three active observatories of the world listed in The American Ephemeris, seventy are in the United States, not including the giant of Palomar, which is now nearing completion. Three of these observatories, Harvard College Observatory, Yale, and the University of Michigan, also maintain stations in South Africa so that they may include in their survey of the heavens the regions of the southern skies, which are not visible in our latitudes. Yerkes Observatory of the University of Chicago, also operates jointly with the University of Texas, the new McDonald Observatory on Mt. Locke, Texas. Harvard has also, in addition to its southern branch, its Oak Ridge Station in Cambridge, and a recently established station at Climax, Colorado, for the purpose of studying the solar atmosphere and, in particular, the corona without an eclipse. For this purpose a high elevation and clear atmosphere are essential. Similar studies of the solar corona without an eclipse are also being undertaken, among other things, at the new McDonald Observatory in Texas. The University of Michigan, which has a station at Bloemfontein, South Africa, known as The Lamont-Hussey Observatory, which is under the joint support of the Union of South Africa and the Municipality of Bloemfontein, operates, in addition, the McMath-Hulbert Observatory, which was deeded to the university by its founders in 1931. It is here that such remarkable results have been obtained in photography of solar eruptive prominences and other solar phenomena.

The work of our observatories is of two entirely different types, and one would hesitate to say that either one is more important than the other. There are observatories whose work is chiefly that of positional astronomy, such as the U. S. Naval Observatory, and then there are the great astrophysical observatories such as, for example, the

Yerkes Observatory and the Mt. Wilson Observatory. Much of the work of the Harvard College Observatory is astrophysical. The Dominion Astrophysical Observatory of Canada at Victoria, B. C., is also an outstanding example of an observatory of this type. In addition to these two distinct types of observatories is the large group of student observatories that make up a large proportion of the seventy American observatories. Many of these are connected with colleges and state universities and the students who take courses in astronomy at these observatories may study positional, navigational and theoretical astronomy, or astrophysics. Chief among such observatories is The Students' Observatory at Berkeley, California, which has graduated many who later became leading astronomers or directors of observatories in the United States. Princeton University, Leander McCormick Observatory of the University of Virginia, and Yale Observatory are in this class.

The United States Naval Observatory at Washington, D. C., which is our national observatory, is engaged chiefly in the work of positional astronomy, which is recognized as the work most pre-eminently suited to well-established, national observatories in which long series of observations of the positions of the heavenly bodies, sun, moon, planets, and stars may be carried on uninterruptedly over many years. Less spectacular than the work of the astrophysicists, it is still of fundamental importance. It is essential for navigation, surveying, the determination of time, and for many forms of astronomical research—even including astrophysics—that we know as accurately as possible the positions and motions of the heavenly bodies. One would not get far in studying the structure of the heavens, distances of the stars, and the like, if we did not have accurate positions of the stars. So thousands of positions of stars, and of the sun, the moon and the planets are observed at our Naval Observatory yearly, and tables and catalogs of star positions are published there and at other observatories, that the astrophysicist as well as the navigator may have the information he needs.

Dry and uninteresting reading, in general, are the three publications of the Nautical Almanac Office of the Naval Observatory, The American Ephemeris and Nautical Almanac, the Nautical Almanac, and the new American Air Almanac. However, every observatory has its copy of the first, every American ship that sails the seas carries a copy of the second publication, while the third, published for the first time last year, is the result of the demand of aviation. To prevent a duplication of work it has been the practice of the leading nautical almanac offices of the world to apportion the calculations of various data that are essential to the publication of all national almanacs among England, France, Germany and the United States. As a result of the war this exchange of work is becoming increasingly difficult, and our Nautical Almanac Office now finds that it must take over the task of getting out alone most of this information, so essential to navigational and other astronomy.

Our Naval Observatory also has the important task of sending forth time signals hourly. The average error of the time signals for the past year as transmitted on 113 kilocycles was 0.009 seconds. The determination of time depends upon observations of stars made on every clear night, that the rates of the transmitting clocks may be known to the greatest degree of accuracy. More than 2600 observations of stars were made at the Naval Observatory last year with a photographic zenith tube, both for this purpose and for the determination of the variation of latitude. With other instruments at the Naval Observatory more than twelve thousand celestial observations were made last year, including sun, moon, planets and stars.

The work of other great American observatories is of the greatest variety and interest; in some instances the results are even spectacular. One can do little more than mention a few of them here.

Astrophysical studies have to do with the stars as physical bodies, their composition, atmospheres, temperatures, size, mass, light changes, also with the sun as a star, sunspots, solar prominences and all the phenomena of the solar atmosphere, including spectroscopic observations.

In addition to astrophysics, subjects of observation and investigation at many of the observatories in this country include the relation between astronomy and terrestrial magnetism; geodetic astronomy, which has to do with the figure of the earth; variation of latitude; computations of orbits of comets, and asteroids, or minor planets; observations of the surfaces of the planets, especially Mars. As an example of the co-operation of astronomers of different observatories, Dr. V. M. Slipher of the Lowell Observatory, which is one of the most noted in the world in the study of the planets, was granted permission by the Observatory of the University of Michigan to make use of their fine 27½ inch refractor at their station in Bloemfontein, South Africa. Dr. Slipher made this long journey to the southern hemisphere to make his valuable observations of the surface of Mars in 1939, because the planet was then so low in the south that observations in our latitudes were of little value. There are many such instances of co-operation between astronomers of different observatories.

Other important work carried on by our observatories has to do with the great spiral nebulas and other types of nebulas, measures of the distances of the stars, and the structure of the universe.

Particularly valuable in all astrophysical work are the fine new Schmidt cameras and telescopes, which have great speeds, with focal ratios as low as 0.5, and wide fields of view. Much is expected of these in the future.

Work on the greatest of all telescopes, the giant telescope on Mt. Palomar, is progressing, and it is hoped that the task may approach completion within a year or so.

Mercury is at eastern elongation on February 10 and will be visible in the evening sky about that time. Jupiter and Saturn are now getting into the western sky and will be in conjunction on February 20, with Jupiter north of Saturn. Mars and Venus are both in the morning sky, but Venus is getting close to the sun and cannot be seen to advantage in the morning twilight. Mars is improving in position steadily and increasing in brightness.

CHRYSANTHEMUM SEPTEMBER JEWELS

This flower, offered by Dreer, marks another advance in the rise of this popular bloom. Sown from seed, it flowers the first summer, blooming early and being resistant to cold

Garden Prima Donnas

By ANDREW S. WING

Garden Editor, Nature Magazine

PLANT novelties for the 1941 season seem quite as dazzling and almost as numerous as in years past, in spite of the disruption of European trade by the War. So many of the good things for the garden are now bred and developed right here at home that there is no dearth of material to draw from, except perhaps in the case of Holland bulbs and in shrubs and perennials. So when you examine the offerings of leading seed and nursery firms this spring you will find plenty that are excellent from which to choose.

A good place to begin is with All-America Selections, since they have the stamp of approval of an impartial committee. While they may not, in all cases, appeal to the gardener as being vastly superior to other varieties not tested, or not in the winning circle, there is no question that all are highly desirable horticultural creations.

The rose still leads as the world's favorite flower, so let us take a look at roses first. Out of about a hundred and fifty new roses seeking to raise their lovely heads above the nearly five thousand already in existence, the rosarians in charge of the fourteen official test gardens have agreed on the following as deserving official recognition:

CHARLOTTE ARMSTRONG heads the All-America rose list. Its blood-red buds open to cerise in warm weather and spectrum-red in cool weather, with lively gold flushes at the petal bases. The long, pointed buds are borne singly on numerous canes, and the foliage is bronzy-green and resistant to mildew. It has only moderate fragrance, but is a decidedly superior rose in almost every respect.

WORLD'S FAIR comes next, a blackish, large-flowering Polyantha, which first attracted attention in 1940. It seems best in spring, when the bloom is blood-red, but cool weather turns the petals a darker color. It has a spicy fragrance, and the flower clusters are large and borne on bushy plants.

THE CHIEF is another red rose with large flowers that have orange bases and begonia-rose tips. Free-flowering and vigorous, the dark-green, leathery leaves are mildew resistant. There is a resemblance to Talisman in the bud form and the fragrance is sweet and fruity.

CALIFORNIA is a glorious orange-colored rose that is especially handsome in the fall. APRICOT QUEEN is light burnt-orange with long, pointed buds that open to a coppery orange-pink, a strong grower and a free

SCARLET GOLD MARIGOLD

This dwarf French double marigold is a Burpee creation and was given honorable mention in the 1941 All-America selections. Good for beds, borders and edges and for cutting

GEUM DOLLY NORTH

This is a lighter orange variation of the well-known Princess Juliana. This Jackson and Perkins feature deserves a place in the early summer garden

bloomer, which makes it popular for cut flower purposes.

DICKSON'S RED is an Irish introduction with a lively "man's red" color that is good for both garden display and cutting. FLASH seems to merit its name in that it is a gleaming orange-scarlet pillar rose that grows to six or eight feet and is the most vivid of any pillar rose.

Another orange rose, not yet All-America but patented, is ORANGE NASSAU. It has pointed petal tips resembling a cactus dahlia, and is rated by its introducers as spectacular. MRS. OLIVER AMES will appeal to those who like a yellow rose, and it has the fragrance of Marechal Niel.

If you do not find a rose to suit you in this group, there are dozens more to choose from if you will take the trouble to do a little catalog browsing.

Next let us take a look at the new annual flowers. Here, as usual, there is a wealth of material to choose from, but the All-America judges, headed by Chairman W. Ray Hastings, have become so hard-boiled that since 1937 no gold medals have been awarded to flowers, or, since 1934, in the vegetable trials. Since the judges went "off the gold standard" silver medals have become almost as coveted by the competing seedsmen and plant breeders, and bronze medals are eagerly accepted.

Petunias and marigolds are still at the top in favor and in general all-around usefulness, being both colorful and comparatively free from attacks by bugs and blights, as well as having long seasons of prolific bloom. Hybridists have concentrated on these two flower families with such outstanding results that the All-America Council in giving them recognition has been accused of having "petunia fever" and "marigolditis". However, that may be a bit unfair as the council has included a new annual phlox, a deep red zinnia, and a pure white scabiosa on the winning team for 1941.

BLUE BROCADE heads the list of petunias. It is violet-blue, all double, of the giant fringed type. It has a rich color, is a prolific bloomer on stock plants and comes one hundred per cent true.

RADIANCE petunia ran a close second in the voting. With its rich cerise-rose flower borne early and freely all season on dwarf, stocky plants, it captured a silver medal.

SPRY is a showy dwarf marigold, the outer petals being a rich maroon, surmounted by a bright, light orange crest. Compact nine-inch plants run uniform in height. This also won a silver medal.

FIRST LADY is a dwarf petunia that bears flowers of a very light pure pink two-and-one-half inches across. Its color and habit are good enough to warrant a silver medal.

ROSY MORN phlox is a brilliant rose, richer than Salmon Glory, which got a silver medal in 1939. It bears large trusses of showy flowers on stems a foot high and was a bronze medal winner.

BLACK RUBY zinnia is a pompom with a distinct velvety-maroon color. It grows up to eighteen inches high and bears many one-and-one-quarter inch flowers on long stems. The color comes about ninety-five per cent true. A bronze medal was awarded.

GOLDSMITH marigold is well-named, a grand tall marigold that is the first of the giant chrysanthemum-flowered type. It is an enlarged golden Dixie Sunshine with golden orange flowers borne on stems long enough for cutting, and won a bronze medal.

VIOLET GEM petunia is "just a ball of a plant", being only six inches tall and very compact. Its star-shaped, violet-blue, single flowers are profusely borne, are excellent for edgings, low borders or for potting, and worthy of the honorable mention received.

PEACE scabiosa is a white version of Heavenly Blue, a 1940 winner. Its pure white flowers are fully double, bee-hive shaped and about one and three-quarter inches across. Honorable mention was its lot.

SCARLET GLOW marigold will be preferred to Spry by many gardeners as the light maroon color is rich and

distinct. It is quite dwarf and very handsome indeed. It was given honorable mention.

All ten of these All-America annuals are outstanding and worthy at least of a trial. They can be obtained from most dealers and mail-order seedsmen.

And now we come to the more difficult task of selecting a few of the other offerings that are outside the All-America group but still outstanding enough to deserve featuring in the new catalogs. Not wishing to play favorites, about all one can do is shake the basket and then pick a few of the more interesting varieties from those that come to the top. Inclusion here does not mean that a plant is necessarily superior to some that are left out, any more than omission implies any lack of merit.

Chrysanthemum SEPTEMBER JEWELS, offered by Dreer, marks another advance in the rise of this popular flower. These are new hybrids that combine early flowering with resistance to cold. Seed sown early in the spring will grow rapidly into well-rounded plants that are one to two feet high and are covered with masses of daisy-like flowers in a medley of shades ranging from yellow to purple and moroccan red, but with the delicate shades predominating, especially pinks. Anyone who has not tried growing hardy mums from seed will revel in the surprises that a packet of these seeds will give him.

In addition, there are quite a few new hardy garden chrysanthemums of note that are available as plants, among them a new series of the striking "spoon" sorts, also offered by Dreer.

FOUR EXCELLENT ROSES
All from Dreer, they are Mrs. Oliver Ames, Apricot Queen, Orange Nassau and California. At the left is Jackson and Perkins' new dwarf *Tritoma galpini*

Zinnias are still on the top of the heap, vying with marigolds for novelty and popularity. HOWARD'S NEW GIANT CRESTED is a striking Henderson innovation, the result of crossing the dahlia-flowered and scabiosa-flowered types. It is almost as large as a small sunflower and the cushiony center is surrounded by broad guard petals. The color range includes almost all the bright zinnia shades, with plenty of good oranges, yellows, roses and crimsons. It is good for cutting as well as in the border.

The War has cut rather severely into the new foreign offerings of perennials and shrubby plants, but there are a few introductions of note, such as the new early-flowering hardy tritomas (red hot pokers) listed by Wayside Gardens. These are not only earlier and hardier, but come in cooler shades—such as white, ivory, and orange—as well as in the more typical fiery-reds. Heights range from twenty-four to thirty inches.

No border is complete without hardy asters, and this tribe has been greatly enhanced in beauty and size in

recent years by improved new varieties. Among the newcomers this year NOVI-BELGII offerings come in several attractive shades: BLUE GOWN, a china-blue that grows to four and one-half feet; PETUNIA, with a petunia-purple flower on plants two and one-half to three feet; and BEECHWOOD CHARM, a lively rose on plants up to three and one-half feet. It blooms until frost and cuts well. These are from Jackson & Perkins, who also offer a number of choice new roses and other perennial novelties including: FAVORITE Shasta daisy, with giant five-inch flowers; a double delphinium named ENCHANTMENT, which has light blue flowers that open all at one time, and side spikes to give later bloom; and two new hardy geums, DOLLY NORTH, a light orange, and RED WINGS, a brilliant semi-double strawberry red with two-inch flowers.

HOWARD'S NEW GIANT CRESTED ZINNIA
Featured by Peter Henderson, this is an innovation resulting from crossing dahlia-flowered and scabiosa-flowered types

Miniature roses made a great hit last season with the garden clubs, of which some 900 ordered PIXIES from one nursery alone. Robert Pyle offers a new one this year in MIDGET, a real little gem that is only one-half to five-eighths of an inch across, borne on tiny plants. The buds are pink, but open out to a red rose and pink, the fragrant flowers being borne in clusters of five or more, and the plants practically thornless. Conard-Pyle offer a number of other miniatures in red, pink, yellow and white, and have their usual quota of other new roses of interest.

Among the newer shrubs that should be better known is the lovely BLUE DAPHNE, *D. genkwa,* which flowers in March or April, before the leaves appear. The plant grows to three feet, and the half-inch flowers, borne in clusters, are a lovely lilac blue. It came originally from China, and has been rare because of the difficulty of propagation, but that difficulty has been overcome, and it is offered to gardeners by Bobbink & Atkins.

Other trees and shrubs of note are a WEEPING FLOWERING PEACH, a pink flowering form grafted on standard stock, and making a showy shrub. This is offered by Kelsey Nursery Service, which also lists GABLE'S NEW HYBRID AZALEAS—not new in the trade but just getting retail distribution. These are a complete race of semi-evergreen azaleas with colors ranging from salmon, through the reds and pinks to purple. The great advantage claimed for the Gable hybrids is that they are not tender like the older Japanese azaleas, being hardy as far north as Boston.

The dwarf blue-leaved ARCTIC WILLOW, *Salix purpurea,* which originated at the Morton Arboretum, was introduced by Wayside Gardens last year, and has proved so desirable that other nurseries are taking it up. It grows only a foot or two high, is hardy everywhere, and will grow in almost any soil including damp clay. It is particularly useful for dwarf hedges.

One could go on and on without exhausting the infinite number of new things that seem worthwhile. But there is no use trying to do more than skim some of the cream from the top. Every gardener will wish to do his own browsing through the catalogs and the advertising pages of the magazines. And by no means should he forget to visit some of the nurseries and seed establishments this season to see some of these things growing. For "seeing is believing", and what has been merely another catalog name may be a delight to behold.

Vegetables, purposely, have been left until last. 1941 promises to be a great vegetable year, and the seedsmen have plenty of new sorts to lure us into having a kitchen garden. Among the All-America vegetables that are worth noting are: YANKEE HYBRID squash; VICTOR tomato, a small, early, smooth variety; TENDER POD snap bush bean, a high-yielding, stringless sort; PROGRESS pea, an early dwarf that resists wilt; ALLEGHENY hybrid sweet corn, a late yellow variety; HONEY GOLD cantaloupe, a small to medium sort that has Honey Dew flesh, and is early and sweet. And, oh yes, we must not forget Burpee's red-leaved Swiss chard, as handsome as a flower, good to eat, and aptly named RHUBARB.

NATURE IN PRINT

As a convenience to readers the books reviewed in the pages of Nature Magazine may be ordered through the book department of the American Nature Association, 1214 16th St., Washington, D. C.

(Continued from page 63)

botanist who took mosses for his province and became a fellow worker with John Torrey, Asa Gray, and other great botanists. It is a story as American as business and the saxifrage genus *Sullivantia*—as American as that of the colonial Bartrams or the successful immigrant Agassiz.

Mr. Rodgers's biography of Sullivant is a definitive factual record, descriptive of the times and associates of Sullivant—a matter-of-fact conservative biography written with no attempt to dramatize or color. Miss Robinson's volume on Agassiz is, as the publishers say, "a creative interpretation . . . in vivid and sensitive prose," exploiting in full the color and drama of Agassiz's life—a book that leaves chronological precision to an appendix in order to recreate a character and the scenes in which he moved. Professor Earnest's work on the Bartrams, in the series "Pennsylvania Lives", is a comprehensive though brief scholarly study, more topical than chronological, rich in quotations from poets and others for comparison, interpretive for the mind rather than the emotions, but written in a lucid prose with the charm of the best literary essays and a simplicity that adds much to one's enjoyments of these eighteenth-century topics.

Each book, however, seems to me to be an outstanding achievement in its own kind of biography. Together they beguile a reader into interesting comparisons of the devious ways of our friends the biographers. One wonders, for example, which author is most satisfactory in dealing with domestic vicissitudes –Miss Robinson in attempting to reconstruct the emotional realities of Agassiz's two marriages; Mr. Rodgers in simply recording the events of Mr. Sullivant's three marriages, all happy but with the tragedy of death; or Professor Earnest, who quotes an inconclusive letter by the life-long bachelor William Bartram and comments: "It seems very much as if William fell in love with his cousin Mary, as well as with the South. An unsuccessful love affair would help to explain why he never married, and why he buried himself for four years in the wilderness. Here may be another of the many strangely assorted elements that went into the making of the *Travels*." In any case, each author has realized fully in his own way that there is more than conventional "natural history" in the life of a naturalist. Additional biographies by any of them will be welcome, and it is good to know that Mr. Rodgers's publishers are expecting to issue a work on John Torrey by him.

The Bartrams were farmers, gardeners, travelers, and thinkers. Agassiz was an immigrant professional scientist, a genius whose zeal for natural history consumed all his energies. Sullivant was a business man. How rich is the natural history of a country that can claim such a variety of distinguished men for naturalists!

Help for Plants

The Plant Doctor. By Cynthia Westcott. The Frederick A. Stokes Company. 1940. 297 pp., illustrated. $2.00.

Our grandmother's garden, tenanted by old-fashioned plants taken into the deeper wilderness by horseback or ox-team, had its troubles in the form of insects, rusts, and viruses. These pests she fought with the simple weapons of those days.

The garden problems of today, however, are no longer simple ones. This is one of the results of our modern methods of transportation. The virtual retirement of horses and oxen, and their replacement by motorized means of travel, has exacted terrible penalties. All this modern speed has increased business, but it has seriously affected the peace of the world.

This book is concerned only with the pests that now make headaches for the gardener. In the exchange of organisms inimical to our growing things, which improved transportation methods have speeded up, we seem to have gotten the worst of the transaction.

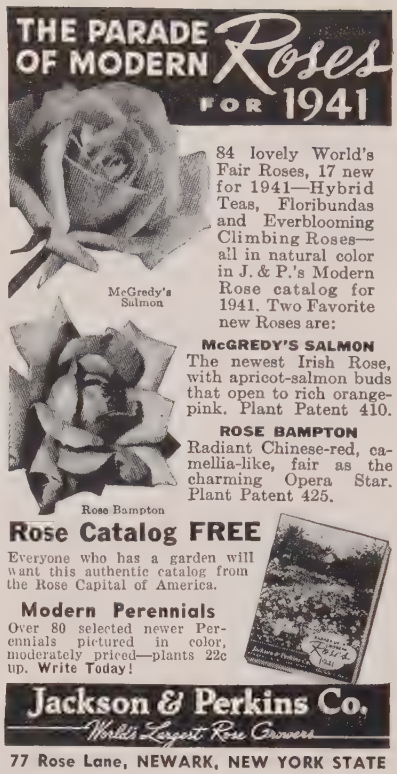
To name only a few of these pests, we have gained some oriental beetles, the chestnut blight, and the elm disease, and we have sent back the potato blight and its bug, the pear blight, and the gooseberry mildews. All these pestiferous things have had ever-easier journeys in their over-sea migrations and they even have been able to travel much faster after reaching land.

In outlining the methods that science has invented to cope with these insects and their relatives, and with the rusts and the viruses, our author has divided the growing year into nine parts, extending from March to November, and has laid out a program of offense and defense for each, with emphasis on our Northeast. She has also treated briefly some of the particular problems of the middle west, the southeast, the southwest, and California. There is also a miscellany of subjects, from *Aconitum* to *Zinnia,* some two hundred in all, and including insects, diseases, enemies and cures. There are five pages of selected references, and a fine index. The book has about 300 pages, a few halftones, and a host of line drawings. It is really worth more than two dollars.—E. A. P.

The Heavens

Astronomy. By Clyde Fisher and Marian Lockwood. New York: John Wiley and Sons. 1940. 205 pages; index. Illustrated. $2.25.

This book is an addition to the series on the sciences being brought out under the editorship of Gerald Wendt. The objective of this series is to supply an obvious yet not generally recognized need created by the fact that many college courses in science are directed toward training scientific specialists instead of providing the students with a good general comprehension of science. In this immediate volume the approach is popular, and the material is carefully selected to achieve the objectives of the series. The result is an astronomy book that will be useful not only in college science work but to any adult desiring to review the fundamentals of the science of astronomy. Realizing that such a volume cannot more than cover the field generally, an excellent bibliography is supplied.



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THE SCHOOL PAGE ★★★

EDITED BY DR. E. LAURENCE PALMER

Professor of Rural Education, Cornell University, and Director of Nature Education, The American Nature Association

Deserts in Schools

The special insert in this number of NATURE MAGAZINE deals with a subject that, at one time or another, is touched upon in most school rooms. The usual impression one gets from the treatment of deserts in a school room is that they are always dry, dreary, dull, deceitful and despicable places. This impression is about as valid as the impression one gets that all Alaska is cold and inhospitable, that all Eskimos live in igloos, and that every Indian wears feathers to keep his wigwam.

As a matter of fact, deserts, or their counterparts, can be studied in all school rooms just as the work of glaciers can be studied by observing the behavior of ice on a sloping school house roof. What would be your answer if I asked you how big a desert was and how long it had to exist to be a desert? True, there is some justice in developing the concepts that time and space are great, but I feel that we spend too much time on that idea if we overlook the equally important concept that there is significance in small units of time and space. While the life span of the human being is too short, and transportation difficulties too unsurmountable, to expect any of us truly to experience the significance of great units of time and space, we all can work with the smaller units. We all can set the stage to see what will happen in a short time in a limited space, and we can both see and interpret the results. It is with this idea in mind that this treatment of deserts in schools is begun.

If we accept the dictionary definition that a desert is "a barren tract incapable of supporting life or vegetation", we would have to rule most so-called deserts out of consideration because most of them do support both animals and plants in more abundance than the casual observer would recognize. So, really, we are not obliged to accept that definition without qualifying and saying that it applies to areas that at times seem to be incapable of supporting life. With this qualification we open up a host of possible deserts almost everywhere. The concrete pavement, the stone sidewalk, the home plate on the baseball diamond, the ash pile, the floor in the hay barn, the cellar floor, and even the school room itself, may be too dry to support life that cannot get food and drink elsewhere. And if there is an "elsewhere" for these common smaller deserts there is also an elsewhere for the larger, more orthodox deserts. Usually the more suitable environment is a few feet underground where the temperature is more comfortable and there is more moisture, but this is not always the case.

Any teacher studying deserts in school, however, would do well to explore the local, small deserts for illustrative materials, and these explorations should be made with all the simple instruments possible. A thermometer with its bulb in contact with an asphalt pavement may give some surprising readings reminiscent of the larger deserts. The moisture content at different levels of supposedly dry limited areas may be explored with such simple equipment as a lock of naturally curly hair, or some streamers of smoothed cellophane. The hairs or the cellophane will remain straight if they are in contact with something dry but will curl or crinkle if there is moisture present. What more does one need to explore slightly the physical nature of an apparently dry place?

In winter, even a marsh may have many of the attributes of a desert. It is more or less functionally dry so far as most living things are concerned. Most plants cannot grow and develop during the frozen season and many of the animals that roam a frozen swamp seek shelter in some burrow below the frost line, much as the kangaroo rats of the desert stretches go below when it suits them to do so. On bitter cold days, the fine hard snow blows and drifts much as do the sands of a desert, and the sun glare from a snow bank may be even greater than the sun glare from white sand.

In the school room there are usually some potted plants, or perhaps a terrarium that has been neglected and allowed to become too dry. What happens to these things in school has significance in studying deserts. One may care to approximate desert conditions by filling the lower third of a flower pot with clay or rich loam. Above this may be placed a layer of fine sand, and above this a layer of coarse sand or even fine gravel. If the pot is set so that water may enter the hole in the bottom the water may make its way up through the clay or loam but rarely up through the surface gravel. Some weed seeds gathered from the dry tops of weeds as they appear in winter and sprinkled over the gravel may give some interesting results, particularly if once a week, or once a month, the gravel is sprinkled with water to give some of the weeds a start. It is suggested that a mixture of wild sweet clover and of some wild mustard such as black mustard might be most useful here. Which of the two makes the better showing and why?

This matter of duplicating desert conditions in a school room, even in such a small area as a flower pot, holds all sorts of educational possibilities. Salt, alkali and other substances abundant in some deserts and suggested in the insert in this magazine may be added to different pots for simple experimental purposes. It is certainly worth trying as contrasted with confining one's study to textbooks alone.

Probably any attempt at performing simple experiments on the effect of lack of water, or the addition of chemicals to soil water, will show how effective are short periods of time in determining whether some animals or plants can continue to exist. The important thing for a trout is not what the temperature of its stream may be for 364 days of the year, but what it will be on the 365th or 366th day as well. Likewise many plants and animals are barred from existence in real deserts by the conditions that may prevail for a relatively short period of time. This of course affects long-lived and short-lived creatures differently. The long-lived individual must have suitable conditions for a longer period of time than does the short-lived one, which may bridge the gap by going into a resting stage of some sort. The average desert is well populated with long-lived creatures that are able to endure a long resting stage, and the shorter-lived living things without such resting stages are generally crowded out.

Classes that get interested in desert life will probably wish to establish little cactus gardens. This is a delightful hobby, and since many of the stores selling cheaper things now stock a variety of cactuses and other plants that can grow in desert places it should not be difficult for any school to have some real objective desert material for study. A good reference book for those wishing to raise them is *Cacti for the Amateur* by S. E. Hazelton, published by the Abbey Garden Press of Pasadena, California.

Of course, deserts have a school appeal outside of science classes. They appear in literature, in dramatics, in history, in economics and in art. Lord Byron, attempting to express freedom from confinement wrote, "Oh! that the Desert were my dwelling place". Again he spoke of "the leafless desert of the mind". Another writer speaks of the futility of wasting "sweetness on the desert air", evidently assuming that the fragrance of desert blooms was wasted. Obviously this writer felt that all fragrance in Nature should be produced to titillate the olfactory nerves of man alone. This circumscribed viewpoint shows a lack of appreciation of the tremendously intricate interrelationships that exist between the living things of the desert. One may excuse this slip by assuming that the writer sought to produce impressions and not an accurate portrayal of conditions on a desert. When, in the Songs of Solomon, we read that the "desert shall rejoice, and blossom as the rose" we assume that the writer considered this to be something miraculous. As a matter of fact the prediction comes true almost every year in almost every desert, to a limited degree at least. But poets, like most of the rest of us, are blind and are not always exact in their portrayals.

I know of no one who has caught the spirit of a desert better with his camera than has Gayle Pickwell in his book, *Deserts,* and those who have attempted to do a similar task with brush or pen are too numerous to mention. Even the cartoonists frequently use the prickers on cactuses to put life into many an indifferent character.

These are only a few of a number of leads that might be followed by a classroom group interested in deserts. One can assume from the movies that the Foreign Legion is active only in deserts and that they alone can wage a successful fight there. The campaigns in Egypt and Libya this winter have given a new significance to deserts in international affairs. Their effectiveness as barriers against invading tanks and airplanes has been changed with the improvements in these machines. Surely, no matter what one may study in school, deserts are worthy of better understanding by all of us.

Bound volumes of Nature Magazine, each carefully indexed, make one of the best Nature study texts anywhere available. The Association has a limited supply of most volumes in stock.

ON THE RECORD

By "Disc"

Two useful booklets for school authorities are announced by the Educational Department of the RCA Manufacturing Company, describing disc material that is evidence that going to school these days is a mighty enjoyable experience. These booklets present a comprehensive listing of special recordings for use in schools from kindergarten to college.

One booklet is entitled *Victor Records for Integrated Units of Learning.* It lists 126 single records and five albums for use in thirty-seven units for the first three elementary grades. The second booklet is entitled *Special Victor Records for Use in Schools.* In this publication are found selected recordings that fit into a wide variety of school courses from social studies to music appreciation. Complete information is supplied, and the text of these booklets has been carefully worked out to be both suggestive and practically useful to teachers.

Copies of either or both of these booklets are available on request by writing to the Educational Department, RCA Manufacturing Company, Camden, New Jersey. In writing we would appreciate it if you would mention that you do so at the suggestion of this department of NATURE MAGAZINE.

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The melodies of Stephen Foster are an integral part of American history and will live as such. They have been recorded widely, but the most recent and interesting handling of the Foster classics is in an album of records made by the Boston "Pops" Orchestra under Arthur Fiedler. Morton Gould, young American composer, has given a rhythmic background and orchestral treatment to these favorite melodies that is both brilliant and beautiful. The result is no medley in the ordinary sense of the word but an arrangement that fuses these songs into a unique and delightful whole. Any lovers of Stephen Foster—and they are legion—will want Victor Album M-727.

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We wonder how often those who enjoy music in a detached sort of way stop to think how truly it is woven into our national history. The Foster melodies are an example, and another is found in some of the songs that reflect the French and Spanish influences of the early days of Louisiana. These songs are not widely known but they breathe the romance of a period and a region. A collection of these songs has been made and recorded in an album entitled "Bayou Ballads of the Louisiana Plantations." Sung in the Creole dialect, by Marguerite Castellanos Taggart, herself of an ancient Creole family, this album (#M-728) is a fascinating collection.

•

"The Green Hills of Ireland" is a song that is made for the tenor voice of James Melton and he does it full justice on a new record (Victor #4533) that has on its reverse Melton's rendition of "Sunrise and You". As we said last month in our "ten best" column, we are easy prey for Irish melodies and this one is no exception.

•

With the world what it is today, memories of the gay spirit of such cities as Paris and Vienna are all the more poignant. No one, of course, expressed better in music the charm of Vienna—that was—than Franz Lehar. During a quarter century of his life he produced prodigiously and beautifully, and a tribute to his contributions is to be found in a new Victor Album (P-44) on the records of which Margaret Daum, soprano; Felix Knight, tenor, and George Gifford, baritone, give us Lehar against an orchestral background supplied by the Victor Salon Orchestra under Shilkret.

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Residents of the National Capital are proud of the National Symphony Orchestra, whose concerts under the direction of Dr. Hans Kindler have become a "must" for music lovers from far and wide. RCA-Victor now announces the first recording by this orchestra, a transcription by Dr. Kindler of "Toccata" by Frescobaldi. It will add to the fame of the National Symphony. It is Victor record #17632.

AN EYE FOR BEAUTY

By ALAN L. BECKET

There is not enough said in this old world to make people appreciate and enjoy what is beautiful. We all show too great a determination to search for things really much less satisfying. We may love the smell of new mown hay and the songs of many birds, yet too many hurry on in search for something "rare."

A meeting held by a group of Nature enthusiasts showed how easy it is to forget the beautiful in our childlike fondness for something new. At this meeting a "rare" mammal was the prize exhibit. An interesting lecture on ferns, with beautiful live specimens, had just been completed. The master of ceremonies took the floor and announced that he had a great treat in store for everyone. Ferns were forgotten and we waited expectantly. Much emphasis was placed on the rareness of the creature about to be shown. It turned out to be an albino mole. Upon the strength of the claim of extreme rareness this little animal completely captured the audience, if one may judge by the exclamations and interest shown at the close of the meeting. Here was an unnaturally colored mammal competing against a beautiful exhibit of ferns, and the freak won. The meeting was composed largely of adults.

Are we not placing too much emphasis on supposed rareness? Are we really doing the mature thing in devoting so much time to searching for rare specimens whose very rareness may be due to some physical defect? Nature has so much of beauty to show that our searching for oddities may be a sign that we are still in our childhood as far as our appreciation of Nature goes.

We should remember that hunting is natural for man. It was the successful hunter among our ancestors who survived. This hunting instinct shows itself, sometimes too plainly, in our collecting habits, whether it be of dollars, bird's eggs, stamps or bric-a-brac. But let us hunt more for the beautiful things to be found in Nature rather than her oddities.

Beauty lies chiefly in form, coloring, song, grace of movement and in behavior and manners. These are things for the eye to enjoy, for the ear to hear, and for the memory to store. The man who notices what is beautiful no matter where he sees it, is a happy man.

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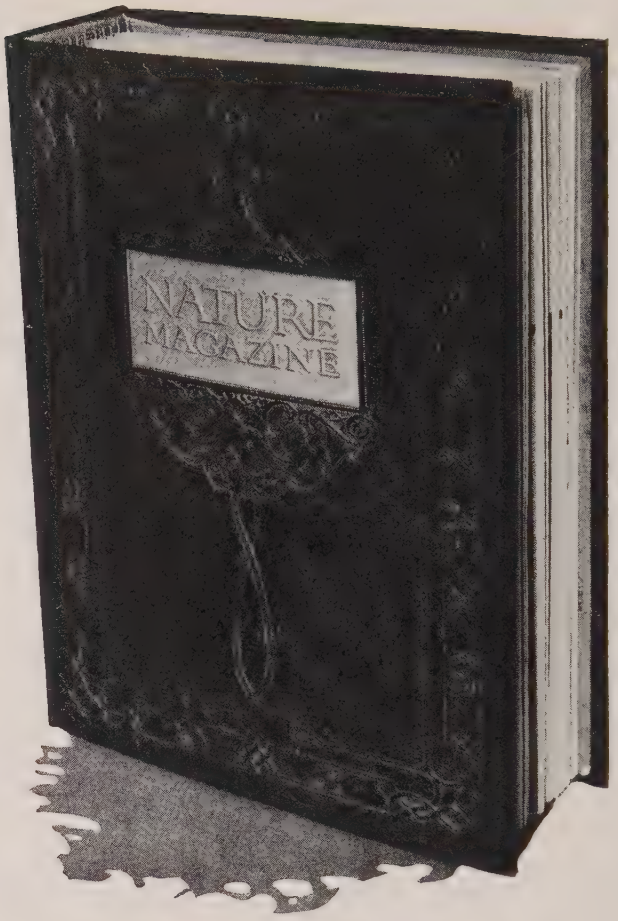

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Keeps six times as many prints as an album

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CAMERA TRAILS

(Continued from page 59)

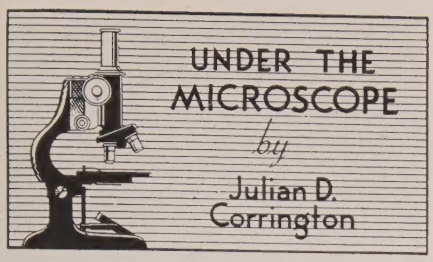
new focusing target in the negative carrier to make focusing easier and faster. For full information write to the distributors, Willoughby's, Inc., 110 West 32nd Street, New York.

The Kalart Company has introduced a new, cheaper synchronizer for cameras whose shutters are of the self-setting type that do not need to be pre-set before making the exposure. The Kalart Compak Speed Flash works up to 1/100th second accurately and uses the new small bulbs. The same company has published *How to Put Life Into Your Pictures,* a 10-cent booklet that contains plenty of helpful information for the Nature photographer and which will be sent to readers of this department free if they mention Nature Magazine when writing for it to the Kalart Company, 915 Broadway, New York City. The booklet will contain a free card that you may take to your regular dealer, who will then give you a free synchronized flash shot with your own camera and one of the Kalart outfits.

The Fotoshop, 18 East 42nd Street, New York City, has published an unusual catalog, the *Fotoshop Almanac Catalog,* that includes not only a large catalog section but also a number of valuable articles and many digests of the more important magazine articles of 1940. The price is twenty-five cents that will be refunded on your first purchase of two dollars or more. Be sure to mention this department when writing for your copy.

Movie makers who feel that they have not enough of their own films to make a good evening's entertainment for their friends will want the new Castle Films catalog of films. Especially interesting is "The News Parade of 1940" that shows many war sequences that were never shown in the commercial news reels. Get your copy by writing to Castle Films, 30 Rockefeller Plaza, New York City, and mentioning Camera Trails.

Don't forget that cold weather may do funny things to your picture making. Outdoors the cold may slow down your shutter—especially the focal plane shutters—by half or more, and the celluloid base of filmpacks may crack as you pull through to the next film. Then, when you go indoors again, the lens is likely to be covered with a heavy fog that will effectively prevent exposures until it is gone. Wiping the front of the lens will not be enough because the fog may be on the inner surfaces as well as on the back of the lens inside the camera. Giving the lens time enough to warm up is the best remedy, but do not expose it to great heat; the cement between the elements may be injured and the heat will not do the camera body and bellows any good either. If they get wet with rain or snow, wipe everything dry gently and leave the camera as open as you can until it is back to normal.



The RCA Electron Microscope

During the last year and a half considerable publicity has been given to a new branch of science known as electron optics and to the invention and partial perfection of a new instrument for work in this field—the ultramicroscope, supermicroscope or electron microscope. The last term is preferred since it alone indicates the principle involved.

Actually not so recent as to discovery of fundamentals, this marvelous invention has reached the stage where it has "broken" in the popular science departments of newspapers and magazines. On the other hand, everyone concerned with the development of electron optics agrees that present instruments represent no more than the crude beginnings of those to come; as imperfect as were the microscopes of Hooke and Malpighi when compared with the highly corrected lenses of today.

In a number of our previous installments we have taken up elementary optical principles, explaining how ordinary microscopes produce a magnified image by refraction of light rays in passing through curved glass lenses, as well as many details in the historical development of optical instruments. For many years it was believed by the scientist—as is commonly believed by the layman today—that there were no theoretical limits to magnification and that the skilled worker need only grind lenses of ever greater perfection and shorter focus in order to attain any specified amount of increase in size of the image.

As far as magnification alone is concerned, this is true, but the far-reaching discoveries of Ernst Abbe, incorporated in his *Theory of Microscope Image Formation,* 1873, brought out clearly for the first time the rôle of the much more important factor of resolution. No matter how high the magnification, if two minute and closely spaced particles cannot be seen as two, but only as a single fuzzy object, then the magnification is useless and is called empty magnification. The resolving power of any given microscope depends upon the medium between lens and object, whether air, water or oil; and upon the width of the cone of light that the lens can receive and fully utilize. About 2000X is the upper limit of the best conventional microscopes, but so many are the handicaps and discomforts involved that 1200X is generally agreed upon as the highest useful magnification attainable by the finest modern instruments. If this final image is projected upon a screen; if it is photographed and the negative enlarged; or is photographed and made into a lantern slide for screen projection, then a further enlargement by some ten times these figures is occasionally possible, although here again there are many hindrances and practical difficulties.

The upper limit is imposed not by the construction or operation of the instrument, but by the nature of the energy-medium by which the object is inspected; that is, by light itself. Light is a form of radiant energy that travels at a uniform speed of 186,284 miles per second, proceeding in straight lines in every

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direction from its source, such as the sun or an incandescent bulb. It vibrates like a water wave or like a rope that one holds in the hand and shakes up and down, but the wave lengths are so exceedingly minute as contrasted with more familiar waves that ordinary units of measurement are inadequate and a new yardstick became necessary as this study progressed. Physicists employ the Angström unit (pronounced ōng-strûm), which is one ten-thousandth of a micron (.0001 mu) or one hundred-millionth of a centimeter, a conception as difficult for the mind to grasp, at one end of the scale, as the astronomer's light year at the other.

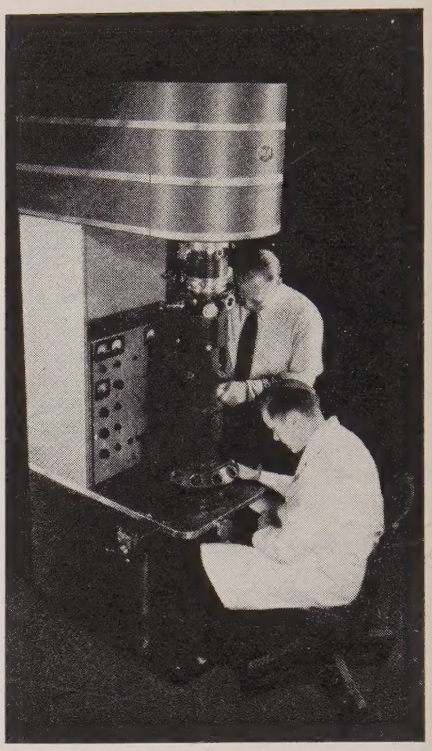
Light constitutes but a very small portion of the whole electromagnetic spectrum, the visible portion of which comprises wave lengths between 8100 and 3900 a.u. (abbreviation for ångström unit). Heat waves lie in the infra-red portion of the spectrum, with waves longer than 8100 ångströms, while ultra-violet rays are likewise invisible to the human eye and have wave lengths shorter than 3900 ångströms. If we take 5000 a.u. as roughly near the middle of the visible spectrum, and remembering that one micron is equal to 10,000 a.u., then ordinary white light has approximately a wave length of ½ micron (0.5 mu), about 1/50,000 of an inch, and this marks the lower limits in size of a particle that can be resolved with the finest microscope, employing white light as the viewing medium. One cannot see an object which is itself smaller in diameter than the wave lengths of the light by which one does the seeing; or, as Harry M. Davis put it in describing attempts to see viruses: "Trying to distinguish these with light is like trying to catch minnows in a salmon net."

The old controversy was definitely settled by Abbe's discoveries—there is no limit to the amount of magnification itself, but useful magnification, as restricted by resolution, is limited by the wave lengths of visible light rays. This conclusion seemed to bring to an end all of the research work on improvement of microscopes and their lenses and to shut the door of optical investigation on the submicroscopic world—the molecule, the atom, the gene and the virus.

A few technicians tried making studies with violet light—that portion of the visible spectrum that includes only the shortest wave lengths—screening out the reds, yellows, greens and blues—but found the results far from satisfactory since this light is exceedingly trying on the eyes.

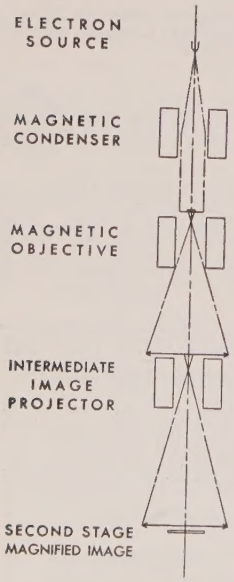
During the nineteenth century ultra-violet rays were discovered, but it was found that while these invisible rays could be recorded on a photographic plate, they could not pass through glass and hence could not be used for studies with then existing microscopes. Finally, in 1903-04, Köhler described and Zeiss manufactured a microscope with all optical parts—condenser, objective and eyepiece—made of quartz, which transmits these rays. Such an instrument is very expensive but permits the making of photomicrographs with wave lengths of 2753 a.u., as emitted by the cadmium spark lamp. This was a considerable advance, raising possible magnifications to 5000X and decreasing the size of particles that could now be seen to about 0.1 micron —one two-hundred-fifty-thousandth of an inch. Man now peered into the upper strata of the submicroscopic universe by means of photographic recordings, but again found the new frontier thus presented to be all the more tantalizing. Most of the objects he longed to see remained invisible, far below the level of ultra-violet wave lengths. Once more an insurmountable barrier seemed to have been reached.

Using the same principle—the employment of shorter wave lengths to see smaller objects—the next step forward was destined to come from an unexpected source. During the last half of the eighteenth and first half of the nineteenth centuries slow but certain progress was being made in an understanding of electricity, in those days thought of as a sort of fluid that flowed along wires. In 1897 Sir J. J. Thompson, English physicist, discovered the electron, a negatively charged particle now believed to be the smallest unit of all matter and electricity and given off at

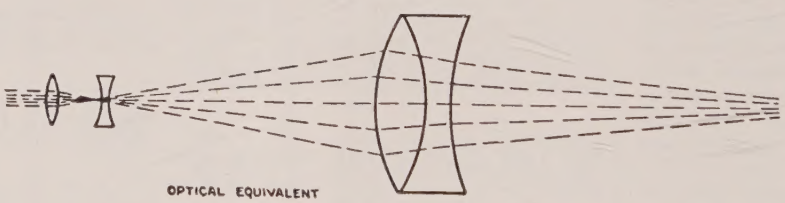


The RCA Electron Microscope with its associated power supply and control panel. Illustrations on this page are courtesy of RCA Manufacturing Company.

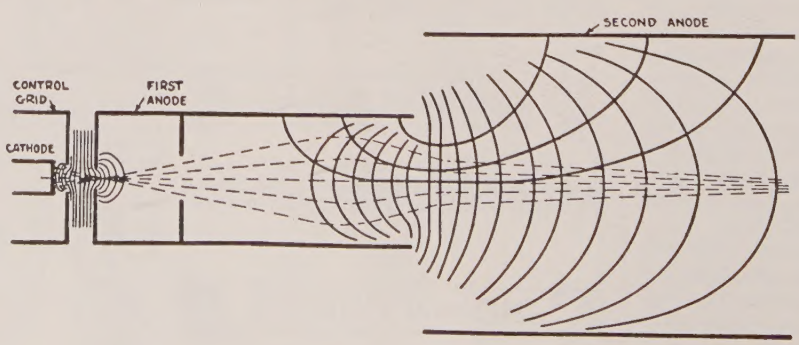
a tremendous speed by the cathode or negative terminal in a vacuum tube. He was able to deflect the stream of electrons by using electrical or magnetic fields and calculated both their speed and their mass. He found that the hydrogen atom, lightest of all atoms, had a mass 1840 times that of a single electron. Later, Robert A. Millikan, American physicist, measured the mass of an electron by an entirely different method. From observations of the effects of electrical charges on minute mistlike drops of oil floating in air, Millikan computed the mass of an electron to be .00000000000000000000000009 gram,



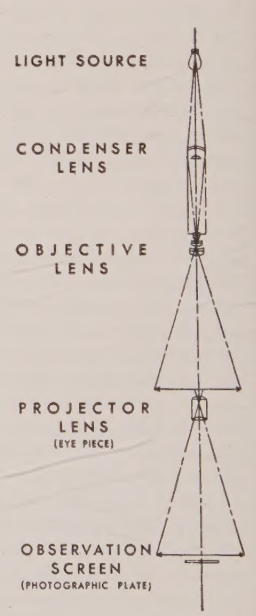
A schematic diagram of a light microscope showing the paths of the light rays and the position of the images.



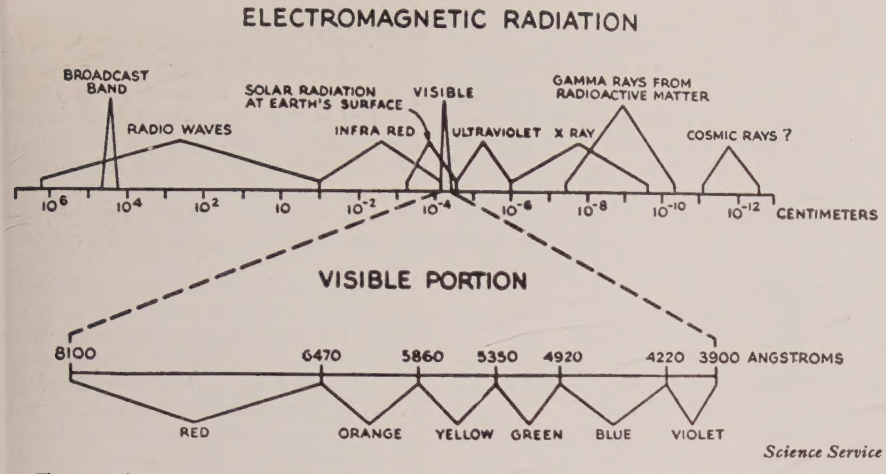
The optical analogue of the electron gun shown on the left. The fields produced by coaxial cylinders form electro-static electron lenses.



The television electron gun illustrates an important application of electron optics.



The electron microscope is similar in principle to the light microscope. Electron lens coils replace the glass lenses of the latter.



The complete range of electromagnetic waves. 100,000,000 angströms equal 1 centimeter.

now written by an ingenious mathematical shorthand as 9 x 10^{-28} gram.

Thus far electrons had been considered as exceedingly tiny particles, constituting matter. In 1924 the Prince de Broglie, in Paris, suggested that electrons, like light, were a form of wave motion; in other words, energy rather than matter. Confirmation of this theory was realized in the Bell Telephone Laboratories in New York when C. J. Davisson and L. H. Germer succeeded in reflecting a stream of electrons from a solid surface, just as a light beam is reflected by a mirror. By this time it had been established that light rays and electrons were parts of a more general system of radiant energy, the electromagnetic spectrum, differing in wave lengths, and comprising long and short radio waves at one end, measured in meters, and with increasing frequencies and shorter wave lengths passing through infra-red, heat, light, ultraviolet, X-rays, electron and finally cosmic rays, the wave lengths of those from light onward requiring ångströms as a unit of measurement.

Today it seems definitely established that electrons and light rays are a form of matter, composed of particles, and also a form of energy, being propagated by wave motion; views considered antagonistic, and still far from harmonized by a complete understanding. Wave lengths of electrons depend on their velocity, as determined by the voltage of the source used in their production. For example, with velocities between 30,000 and 100,000 volts, the wave length of the resulting electrons is one hundred thousand times shorter than that of visible light. If we take 5000 a.u. as representing the wave length of average visible light rays, then electron waves have a length of only .05 ångströms. If this sort of discovery keeps on at the present rate, we shall reach a point where even the ångström unit is inadequate as a yardstick!

Much pioneering in the fields of radio and then television has paved the way for electron optics, which may be thought of as a by-product of radio. Two German scientists were first in the new field, Bodo von Borries and Ernst Ruska, and the electrical company that developed the first of these new electron microscopes was Siemens & Halske, A. G. Then R C A, at their Camden, New Jersey, plant, started their own research, centering around Dr. Vladimir K. Zworykin, television expert, who had already learned how to focus beams of electrons. Dr. Ladislaus Marton was obtained from the University of Brussels and James Hillier from the University of Toronto. The necessary electrical circuits were developed by Arthur W. Vance. By the advent of the Christmas holidays of 1938, Dr. Zworykin was able to demonstrate electron microscopes to the hosts of scientists gathered at Richmond, Virginia, for the annual meeting of the American Association for the Advancement of Science. The first models were as big as a small house; now, as seen in an accompanying illustration, they have been cut down considerably. This is likewise true of the cost; you may place an order for one of these instruments any time you wish to part with $9500.

The R C A electron microscope may be compared, part for part, with a photomicroscope—let us coin this last name as a convenient one to use in speaking of the familiar instrument that uses light as the observational medium—and in fact the inventors and manufacturers use the same terminology in describing parts of the new machine. Every light element is replaced by a corresponding electronic element. The light source becomes an electron source, and lenses are represented by magnetic fields.

In the model illustrated, regular a-c power lines supply current to the high voltage and also the coils that serve as lenses. The electron source is operated at voltages between 30,000 and 60,000, and is housed in the large overhead lead casing, affording ample protection to operators from this dangerous voltage as well as from the X-rays and electrons generated. The interior of the vertical metal tube is a high vacuum, since only in such a medium can the electrons flow unimpeded by molecules of air or other gas. They emanate from the end of a hairpin filament of tungsten and hurtle downward at the prodigious speed of almost one hundred thousand miles per second, but even at such a pace they can be deflected and controlled by sending electric currents through coils that produce magnetic fields. These can be arranged so as to converge the electronic stream to a focus, or fanned out in diverging fashion to form an image.

In a photomicroscope each lens is a fixed optical unit, and the magnifying power can be varied only by means of the sliding drawtube or interchangeable objectives and oculars. Focusing is performed by changing the distance separating object from optical system, usually by moving the latter up and down, sometimes by vertical motion of the stage. In the electron microscope, on the contrary, the distance is fixed but the lenses are variable. Being created by a current flowing through a coil, each lens is continuously variable within wide limits, rather than in

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At right is the Bausch & Lomb DDE research microscope. With usual lens equipment it sells for $774.50. It is doing useful work in many of the world's most famous hospitals and research laboratories. At left is the Model R, a microscope built for amateur use. It was designed by the same scientists responsible for the DDE, is built in the same factory, to Bausch & Lomb precision standards. Complete with case and 455-page book written by Dr. J. D. Corrington, it sells for $21.

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steps. In effect this is more closely related to the operation of the living, flexible and changeable lens of the human eye, rather than that of the rigid and unchangeable lens of glass.

Starting from their source, the electrons are first corralled into a beam and concentrated on the specimen by means of a condenser lens coil. After passing through the specimen, the electrons are next focused by the objective coil so as to form an intermediate image, corresponding to the real image of the objective of a photomicroscope, and this is next magnified further by a projection lens coil, like a projection eyepiece of an instrument used with light. The final image is seen or photographed upon a screen, hence a strict comparison should be made to a photomicroscope equipped to project the final image upon a screen or a photographic plate in a camera rather than to visual observation through an eyepiece. We have seen previously in this series that photomicrography embodies the same principles as projection—throwing a real image on a screen for viewing by eye or recording by photographic plate, and this is the method of study with the electron instrument.

Owing to the necessity of operating in a vacuum, certain important differences in the two kinds of microscope are required, and quite ingenious have been the solutions of the difficulties thus presented. No solid stage with spring clips to support a glass slide is seen—glass is impervious to the electron beam. The object is supported on a very thin sheet or membrane of nitrocellulose, suspended across the opening of a fine meshed screen, and clamped in the tip of a cartridge, which is in turn supported by a plate that constitutes a movable stage. Motion is transmitted to this stage from outside by means of fine screws and metal flexible bellows.

The final image is a shadowgraph in black and white, rendered visible on a fluorescent screen, prepared by treating the receiving surface with a chemical which, when struck by invisible electrons, will give off visible light. A solid portion of the object interrupts—absorbs—the electrons that strike it; there will be none from that area of the field to affect the fluorescent screen, no visible light will appear at the corresponding spot on the screen, and hence that area remains black. Electrons passing downward on all sides of the solid portion of the object will be unimpeded, will affect the screen and cause it to fluoresce with visible light. Accordingly the solid portion is black, outlined with light, in the visible image—a silhouette. Varying shades of light and dark or degrees of density within the object will permit varying numbers of electrons to pass or to be absorbed, as the case may be, and hence a certain amount of internal detail is possible in the scanned image, although never the wealth of intricate detail seen in the image of a photomicroscope. This is one inherent defect that limits the possibilities obtainable with the electron instrument, at least at the present time.

Three pairs of observation windows permit three people to employ binocular vision in viewing the image simultaneously. Removing the fluorescent screen and inserting a photographic plate just below the screen level allows a permanent recording of the image. Specimens are changed and photographic plates removed or inserted by an adaptation of the air lock of a submarine or decompression chamber, and recent models incorporate a number of interconnected operations that speed up and simplify such changes as well as reduce the chances of accidentally breaking the high vacuum through inadvertent manipulation of the vacuum valves.

To change a specimen, the operator works one handle on the outside of the microscope. This lifts the specimen from the objective lens, places it in a separate compartment, and isolates this compartment from the main body of the instrument. Moving a second handle then releases the outside door to this compartment and at the same time breaks the vacuum in this chamber. The specimen cartridge is then replaced by another, previously prepared, and the reverse procedure followed; operating the second handle clamps the outside door, closes the inlet valve, and opens another valve that connects the compartment with an auxiliary pumping system. After a thirty-second interval, an added movement of this same handle isolates the compartment from the auxiliary pumping system, then a final operation of the first handle opens the compartment, removes the cartridge, and places it in the objective field ready for work. So exact is this replacement that should a specimen be removed and later replaced, the same field is obtained and no more than a slight adjustment of focus, if any, is necessary.

Initial adjustment of the specimen is made possible by three viewing ports at the level of the intermediate image. Here a fluorescent screen gives a visible image magnified about 100X, low enough to permit selection of that part of the object in which one is most interested, and positioning for further magnification by the projection lens.

The photographic plate is changed in an entirely similar manner. A recent improvement employs a long plate on which several images may be captured in succession in a series, effecting a great saving in time and manipulations.

The microscope illustrated gives magnifications ranging between 1500 and 25,000X, and the definition of the photographs is sufficiently fine that enlargements up to 100,000 or even possibly 200,000X are obtainable. In general, the magnifying power is fifty times as great as the top performance of visual microscopes, and the resolving power correspondingly greater because of the much shorter wave lengths by which the object is irradiated. Continuing the simile of Mr. Davis, and speaking of electrons, "a material had been found out of which to weave a net fine enough to catch the smallest minnow."

A second inherent defect in this method of forming enlarged images results from the deadly nature of electronic bombardment. Living material is killed instantly by these speedy particles—entirely aside from the fact that a vacuum is hardly conducive to life processes. Hence no highly magnified views of living bacteria or protozoa can be obtained. The electron microscope supplements but does not supplant its older brother instrument.

Purists object to the use of the term *photo*graph or photomicrograph for the pictures made by electrons, since light is not the medium employed. Electron micrograph, if you please.

Now that we have analyzed the instrument itself, and grasped to some extent the fundamentals of the principles involved, what are the uses to which this new invention has already been put, and what are its future potentialities?

The first electron micrograph was produced some fifteen years ago, long before the technical refinements we have just described made their appearance. It was a crude shadowgraph of a dollar bill, laid on a photographic plate and subjected to an intense beam of cathode rays. Today biologists are micrographing bacteria, while the research laboratories of all of our basic industries are studying colloidal particles, dusts, fibers, pigments and a host of other materials, and learning many new facts as to their composition.

Progress to date, however, is admittedly insignificant compared with that to come. Watch for some startling developments in the near future as electron techniques are improved and magnifications stepped up. Scientists in general are intrigued over the possibility of seeing the genes that are the actual bearers of hereditary characters; the viruses that cause such important human diseases as smallpox, infantile paralysis, influenza and the common cold, and which may be living organisms or no more than complex protein molecules; vitamins, those so potent food substances, lack of which in the diet results in dreaded deficiency diseases, such as scurvy, pellagra and rickets; hormones, the chemical messengers secreted in the ductless glands and sent via the blood to all parts of the body to effect normal growth, food utilization, or other basic function; and enzymes, the activators of digestion and food storage.

Most of all, scientists want to see pictures of the structure of molecules and atoms, and even these should be possible. A million volts will speed electrons along at a pace nearly twice that now attained, more than 175,000 miles per second in fact, and produce a wave length of about .01 a.u. The Van de Graff generator has already succeeded in piling up this tremendous voltage, so such power is no longer theoretical.

Chemists have for years labored long and mightily to build up a picture—the space-lattice design—of various molecules, by indirect methods. If they could actually see these molecules, who can say what further advances in organic chemistry would result? Already we have many new industries centering around plastics and such synthetics as neoprene, rayon, nylon and a long list of others. Since it has been computed on theoretical grounds that carbon and hydrogen atoms are two ångströms apart in a carbohydrate molecule, a wave length of .01 ångström ought to permit the making of micrographs of such a molecule and allow chemists actually to see their theoretical space-lattice.

Every new discovery opens up undreamed pathways. In addition to further knowledge of these various enumerated objects, we may confidently expect other and wholly unanticipated results, some of them possibly of far reaching importance and in the not too distant future.

Owing to the space necessary properly to present the story of this significant development in the field of microscopy, the trade notes and information about the American Society of Amateur Microscopists have been omitted this month.